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The cable is type approved to MoS Specification EL 1736.

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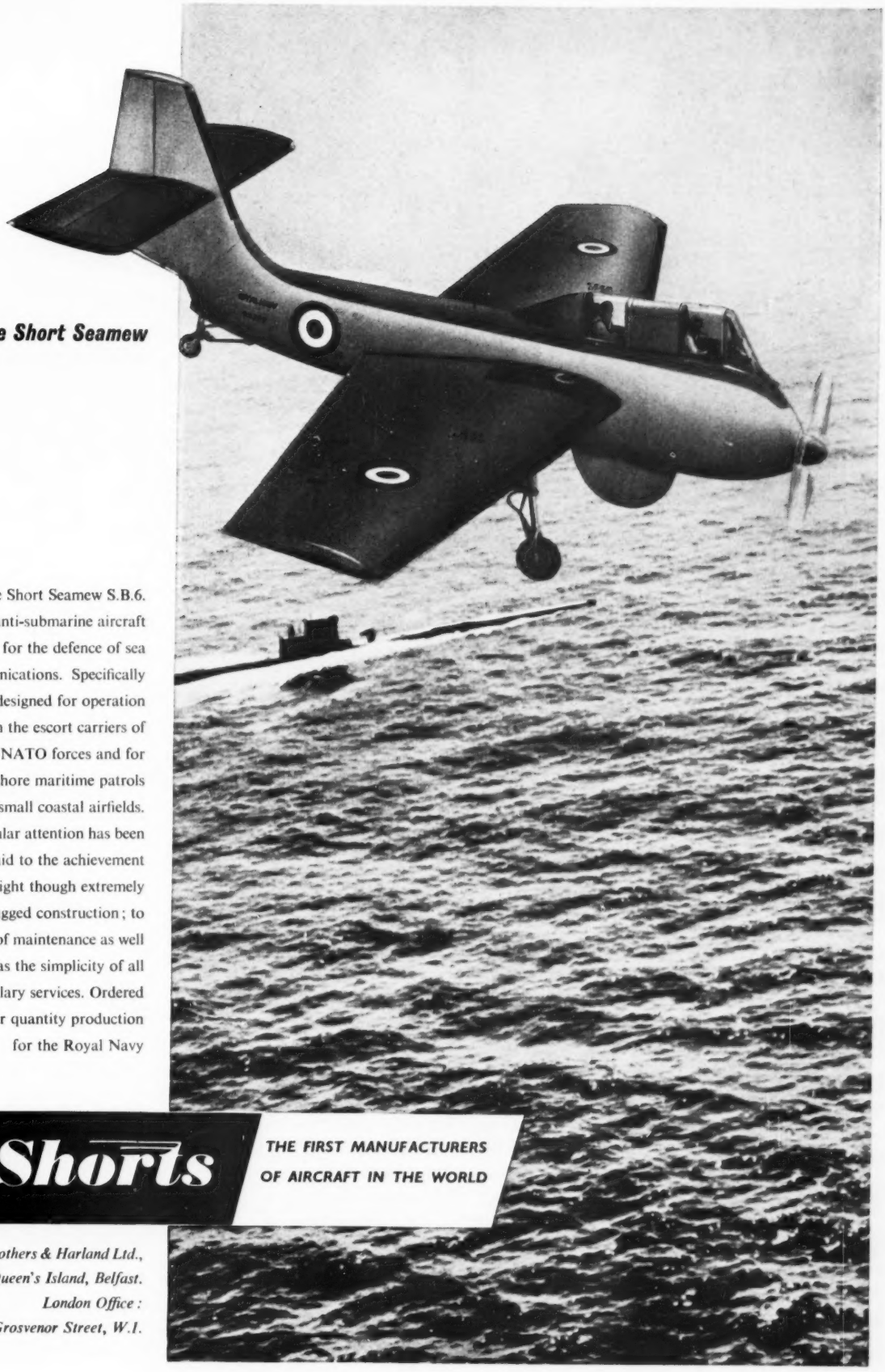

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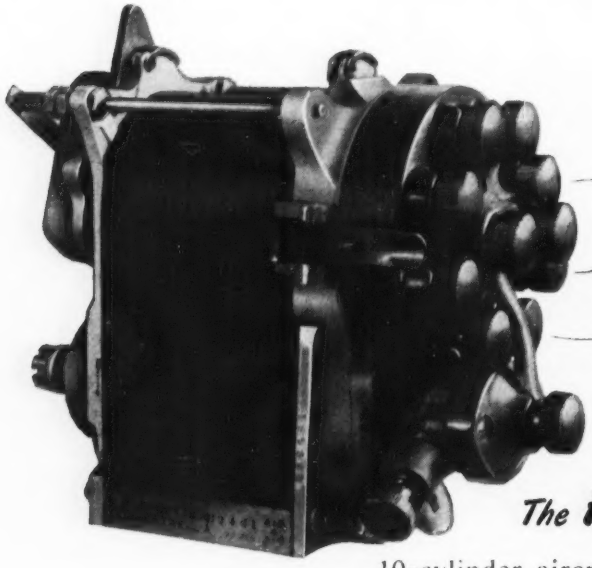

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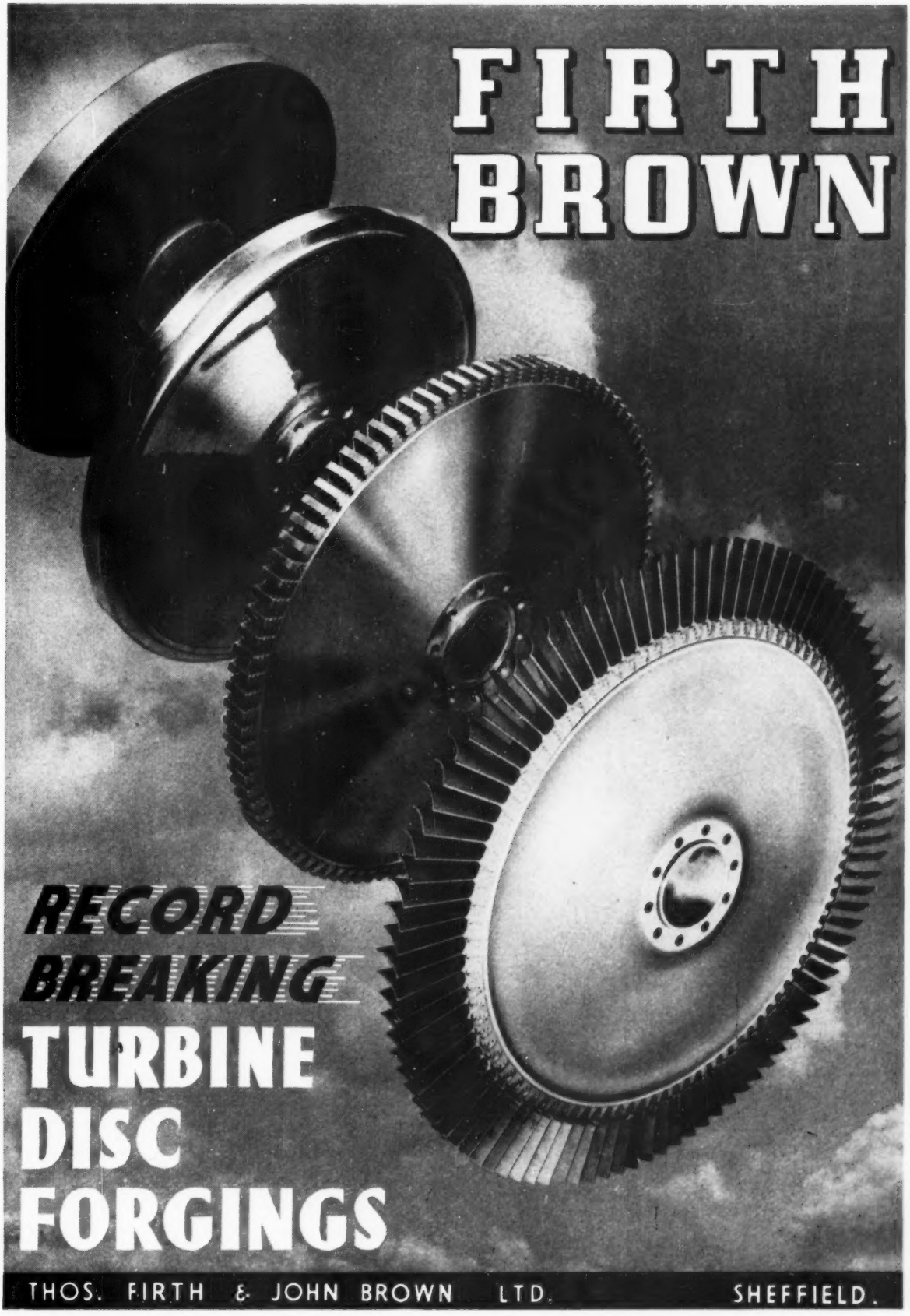
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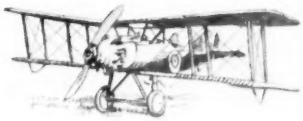

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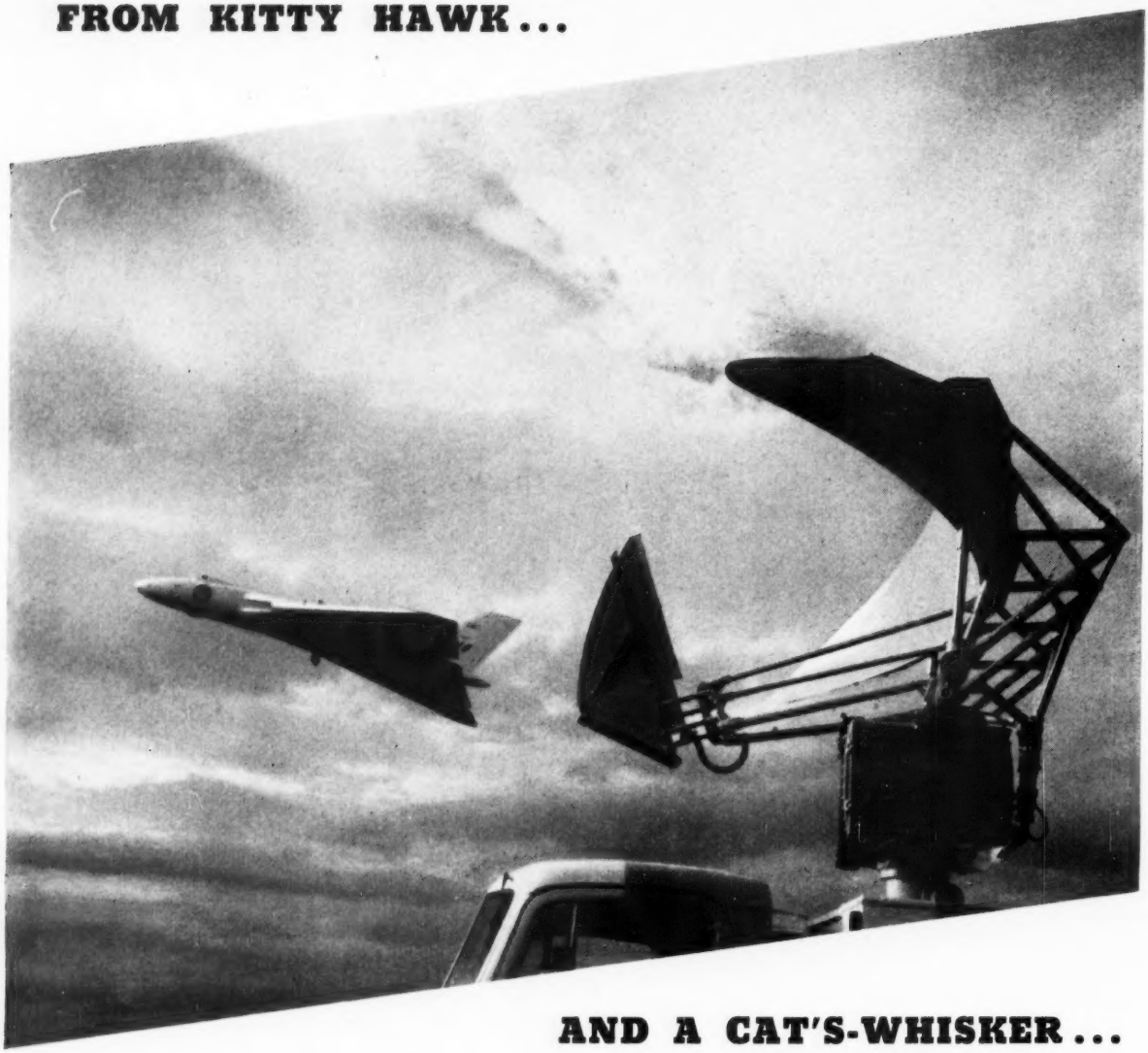

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Barely fifty years separate the Vulcan from the tiny 12 H.P. biplane which, at Kitty Hawk, North Carolina first carried a man in powered flight. An almost unbelievably short time when you think of it. Yet only a little over half that period separates catswhisker wireless from the complex radar equipment which makes the control and landing of a modern aircraft possible in any weather.

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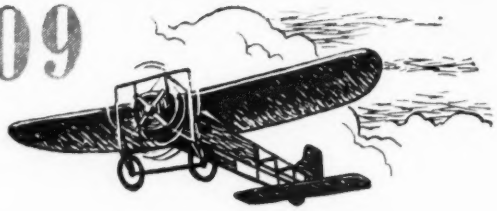

1911 **Rubery Owen issue their 1st Aircraft components catalogue**

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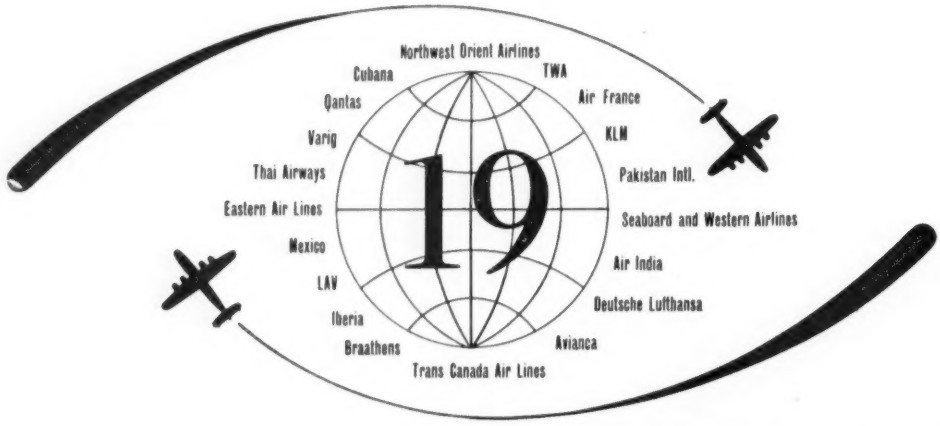

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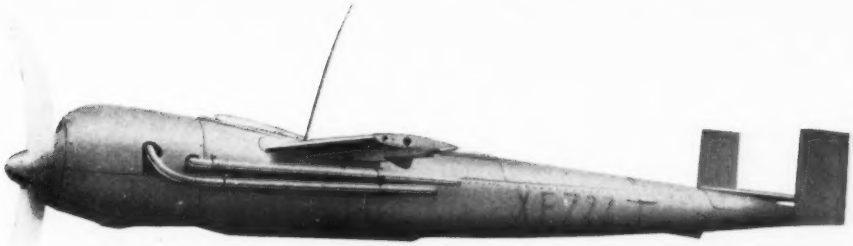

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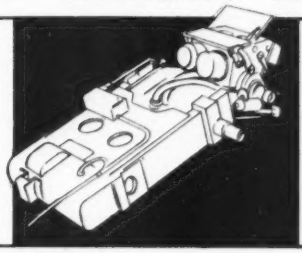

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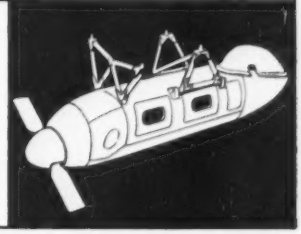

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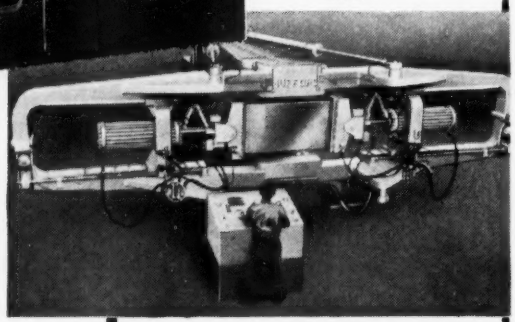
Left. Stretch-Wrap Forming Machine for Extrusions, Brake Formed Sections, Rolled Sections, etc.

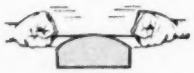
Below. Stretch-Wrap Forming Machine for sheet metal work.



Due to the stretching process, metal strength is actually improved. Hufford Stretch-Wrap Forming can be applied to aluminium and many of its alloys, various steels, including stainless, magnesium, etc. The machines, available in stretching capacities from 12 to 350 tons, accurately form both structural parts and sheets for the construction of frame elements and skin surfaces.

Now accepted as the world-wide standard of the aircraft industry, Hufford Stretch-Wrap Forming machines are making a valuable contribution to increased productivity in the metal forming industries. If you want to know more about Hufford Stretch-Wrap Forming write to the Wickman Technical Publications Dept., for further details.

THE HUFFORD STRETCH-WRAP FORMING PRINCIPLE IN 3 QUICK STEPS



STRETCHED in front of a stationary die, metal becomes semi-plastic.

WRAPPED around die, plasticity aids in moulding metal to die contours.

FORMED at end of wrapping stroke, a final stretch permanently "sets" the shape.

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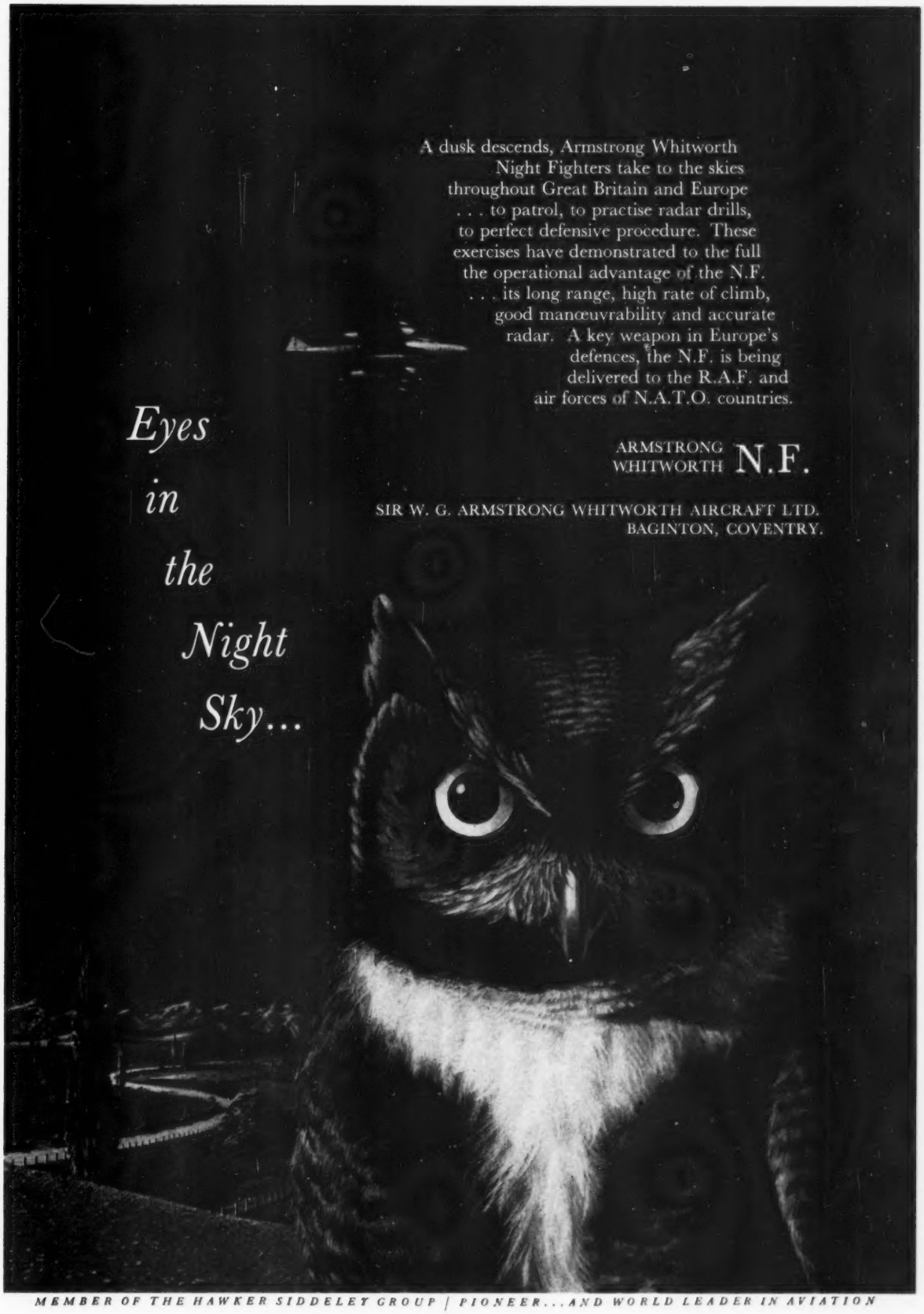
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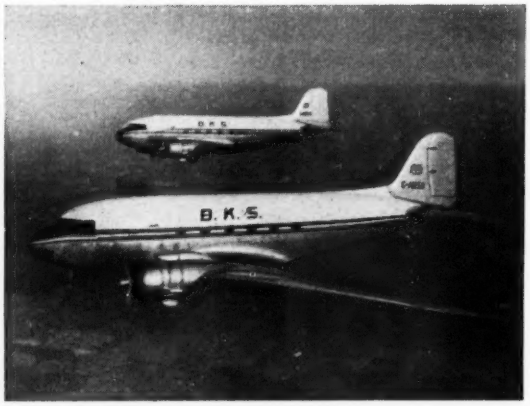

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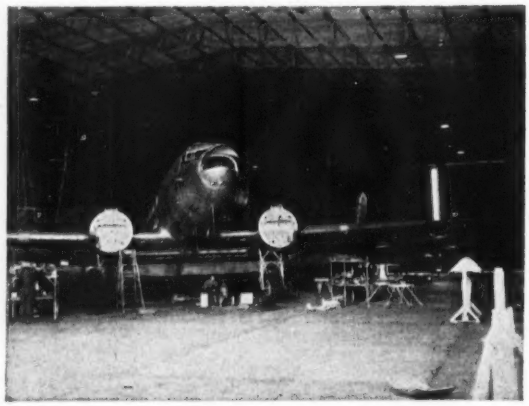

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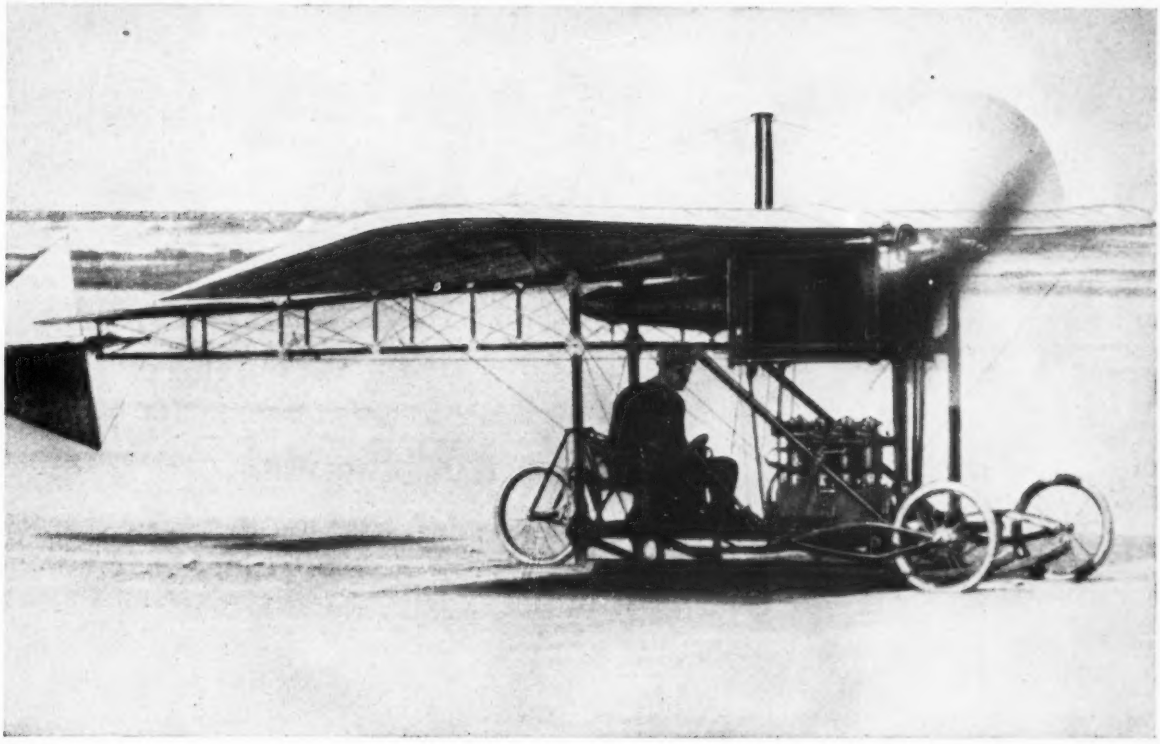

WITHIN five years of the Wright Brothers' first flight, Robert Blackburn designed and built his own aircraft which he flew in 1909. This machine was the forerunner of a long line of Blackburn aeroplanes, including the 1912 Monoplane, which is the oldest British aircraft flying today.

THE latest Blackburn product is the "Beverley" Transport, in production for the Royal Air Force. One propeller of this great freighter weighs more than the original aeroplane of forty-five years ago.

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Founded 1909

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After the Wrights

FLYING is growing up; and this jubilee issue, which shows at a glance the formative stages and present extent of aircraft development, mirrors the fact clearly. Our main feature is illustrated by no fewer than 271 pictures. Almost every one of them tells a story. If, in the aggregate, they—and the accompanying notes—teach a lesson, it is that mediocrity has never had, and should never have, a place in the business of flying.

A second feature in this issue makes it very plain that this same business is a curious amalgam of razor-keen competition and friendly co-operation. By razor-keen we in no sense imply the use of cut-throat tactics; indeed, we may claim without sanctimoniousness that the flying world is freer than most others from skulduggery and chicanery. Nevertheless, in no other industry is rivalry more marked—or more productive. The incessant demand for improvement, and the almost weekly introduction of something new, keep all concerned on the very tips of their toes. In the 44 years during which *Flight* has recorded the changeful scene there has rarely been a dull patch.

It is, indeed, a great and exciting game in which we find ourselves, and one still full of promise for mankind, though, in all conscience, the aeroplane has been a means of bringing—and may yet bring again—appalling horror and misery.

Certainly, in looking back over this half-century of jobs well done, of barriers surmounted (or crashed!) and of benefits accrued, those whose courage, skill and acumen have brought our industry to its present prominence may feel content that they have faithfully followed the lead of the methodical Wrights.

The pace is ever quickening, the field broadens, and even the cleverest cannot tell what lies beyond the next horizon.

Proportions for Lift and Drag

OBSERVERS of the aviation scene might be pardoned for imagining that after fifty years some standard wing-forms might have emerged for certain of the more familiar duties. As the pages of this issue indicate, almost every shape and configuration imaginable must have been tried out. Though they are primary and all-important components, wings are like fingerprints in that no two are exactly similar. They are even subject to fashion, but at least we have learned not to flap.

Today more than ever before the sky is filled with a great variety of wing shapes. Very confusing it must be for the layman to hear and read of the experts advocating completely different shapes to do the same job.

Far be it for us to attempt to sort out and justify even the wings of bombers. We would, however, try to be helpful by stressing one or two basic features to be recognized before trying to assess the merits of aspect ratios, drag, weight, cost, thickness, rigidity, loading, sweep or stowage space.

First of all, then, the shapes may be broadly classified as for operation at low speed; for high but sub-sonic speed; or for well over sonic speed. In order, these three classes might be represented by large, thick, straight wings; relatively smaller, thinner wings with swept-back leading edges; and much smaller, very thin, straight wings of very low aspect ratio.

Of sweep-back, we would recall that it may be used for stability in tail-less designs or—more likely today—merely to postpone the compressibility drag rise as the transonic speed region is approached. Although many aircraft have achieved just over sonic speed and a few American machines a great deal more, very little is known about flying at speeds around that of sound. It is with this that most of the wing-design activity is concerned just now. To date we have blundered through the barrier by brute force.

There is perhaps some comfort to be derived from the thought that in another ten to fifteen years the advent of long-range supersonic flying will have relegated the claims of deltas, crescents, vees, cusps and isoclinics to academic history, and that the present difficult transonic speed bracket will have been passed. This is not, however, to say that there will be no demand for subsonic aircraft. Presumably saucers are round, though planks may not all be rectangular.

FROM ALL QUARTERS

A Canberra at Kitty Hawk

THE winning Canberra in the England-New Zealand Race is to visit Kitty Hawk, North Carolina, on December 17th, as a participant in America's main Wright anniversary ceremony. Flown by its race crew, F/L. R. L. E. Burton, A.F.C., and F/L. D. H. Gannon, D.F.C., the machine will pass over Kill Devil Hill, the scene of the Wright brothers' first successful powered flight.

The anniversary celebrations in the U.S.A. will take place from December 14th to the 17th. The Royal Air Force was invited to participate by the sponsors of the event—the Kill Devil Hills Memorial Society, the Air Force Association, the National Parks Service and the North Carolina 50th Anniversary Commission.

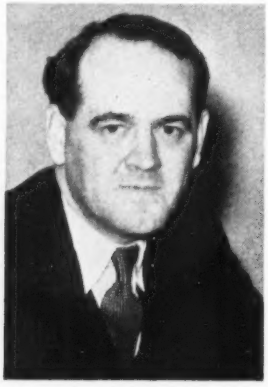
The Canberra, WE 139, is to leave Wyton, Huntingdon, on December 16th, and will return from Elizabeth City, North Carolina, on the following day.

The memorial on Kill Devil Hill, erection of which was authorized by Congress in 1927, is now being officially re-named the Wright Brothers National Memorial.

New M.O.S. Post

THE Ministry of Supply announces the establishment of a new post within its organisation, that of Deputy Permanent Secretary. The D.P.S. will be responsible for day-to-day management of departmental work, thus leaving the Permanent Secretary (Sir James Helmore, K.C.M.G.) freer to concentrate on general research and production policy. Sir James will continue to be the Accounting Officer with responsibility to the Minister.

Mr. F. C. Musgrave.



Mr. L. J. Dunnett.

Appointed to the new post is Mr. F. C. Musgrave, C.B., who up to now has been a Deputy Secretary. He himself will be succeeded by Mr. L. J. Dunnett, now Under-Secretary (Air).

Mr. Musgrave, who is 53 years of age, served in the Army during World War I. He entered the Civil Service in 1919 and was H.M. Inspector of Taxes from 1920 to 1937. Thereafter he was, successively, Principal, Air Ministry; Assistant Secretary, M.A.P.; Principal Assistant Secretary; Under-Secretary (Air), M.o.S.; and, as stated above, Deputy Secretary.

Mr. Dunnett, now 39, joined the Air Ministry in 1936. From 1937 to 1944 he was P.S. to the Permanent Secretary; thereafter he went over to the civil aviation side, and in 1946 was appointed Head of Planning, M.C.A. From 1948 until he went to the M.o.S. in 1951, he was M.C.A. Under-Secretary.

Helicopter Ground Resonance

AT the Royal Aeronautical Society on Friday last, December 4th, a paper entitled *Ground Resonance of the Helicopter* was presented before members of the Helicopter Association. The co-authors were Mr. R. M. Howarth, M.A., and Mr. C. H. Jones, B.Sc.(Eng.), both of the Bristol Aeroplane Company.

In their paper, the theory of self-excited mechanical oscillations of hinged rotor blades put forward by R. P. Coleman was briefly reviewed and compared with results obtained from model rotor tests. General agreement was found between theory and test results. The theory of a rotor of idealized supports was then applied to a single-rotor helicopter of known hub impedance, and experimental methods for determining the impedance were described. Finally, the influence of ground resonance on undercarriage design was reviewed.

Mr. C. F. Uwins, managing director of the Aircraft Division of the Bristol Aeroplane Company, was chairman of the meeting, a full summary of which we hope to print in an early issue.

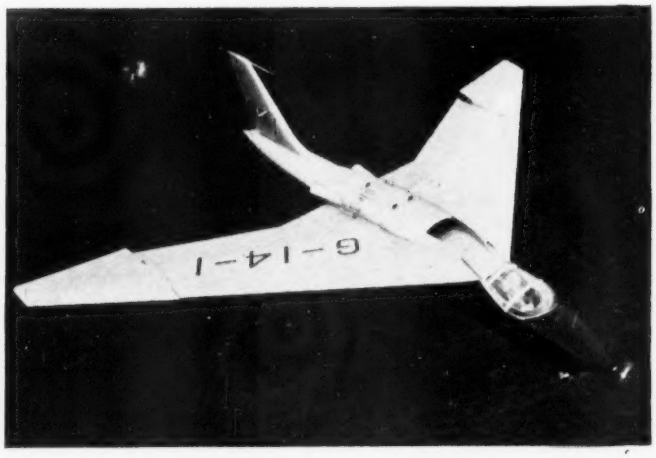
SONIC DUTCHMEN: Six Dutch and Belgian pilots recently visited Dunsfold to obtain initial experience on the Hawker Hunter, which will be the standard fighter of both countries. All six pilots flew beyond Mach 1 for the first time; they were: Majors R. van Arkel, J. L. Flintermann and V. J. Vyzelaar, of the R.N.A.F. (left to right, above), Major C. Sonderman, Prince Bernhardt's personal pilot; and Major R. van Lierde and Capt. Y. Bodart, both of the Belgian Air Force. In the photograph is the tail of a production Mk 1 Hunter, WT 563.

McKenna Trophy for Swedish Officer

WHEN G/C. S. Wroath, A.F.C., Commandant of the Empire Test Pilots School, Farnborough, donned the famous "headmaster's titfer" at the School's McKenna Dinner last Friday, it was a worthy company to which he addressed himself. Guest of honour was Air Chief Marshal Sir John W. Baker, K.C.B., M.C., D.F.C., A.D.C., newly appointed Controller (Aircraft), M.o.S. The Italian Air Force was represented by Col. Cesare de Porto, the Royal Swedish Air Force by Capt. Hessle; and there was a fitting attendance from the Royal Navy, the R.A.E., and the A. and A.E.E. It was the industry, however, which made the strongest showing, in the persons of Neville Duke, Mike Lithgow, Bill Pegg, Geoffrey Tyson, John Cunningham, Gordon Slade, Jimmy Orrell, Jock Bryce, Ben Gunn, Eric Franklin, Bush Bandidt and Dick Whittington—a number of them "old boys."

The course then finishing, said G/C. Wroath, was the twelfth. It had started with 26 students, but two had been found unsuitable and had left after six months. Distinguished passes had been gained by S/L. R. A. Harvey, A.F.C., Lt. (E) J. T. Checketts, R.N., F/L. A. D. Dick, and Capt. Bengt Fryklund, Royal Swedish Air Force. Thunderous applause greeted the group captain's announcement that the McKenna Trophy this year went to Capt. Fryklund and that F/L. Dick was runner-up.

That the international character of the School is being main-



BIRDLIKE: a new "Flight" air-to-air portrait of the Short Sherpa, secured near Belfast during its recent public demonstration (See page 752).

FLEXIBILITY: As discussed on p. 752, Comet take-off technique is rendered both flexible and foolproof by the use of a revised wing section and additional thrust. Here, a production Comet 2 gets away steeply at its full load of 120 000 lb.

tained was shown by the Commandant's figures for overseas representation on the course then concluding: U.S. Navy, 2 students; U.S.A.F., 2; France, 1; Italy, 1; Sweden, 1; R.C.N., 1; R.C.A.F., 1; R.A.A.F., 1. The Royal Navy had sent four pilots, the R.A.F. eight, and there was one civilian—Mr. R. V. Morris, of The Fairey Aviation Company.

Rising to present the Trophy, Sir John Baker described himself as a "salt-horse" airman and his new post as "responsible and exciting." Before he had been ten years in the Service, he recalled, he had flown D.H.s 1 to 10—adding with a twinkle of satisfaction that he had now flown the D.H.100. As for what he called the "frosted glass of the future," the air marshal firmly proclaimed that we in Britain were not just *saying* that we had the best article; we just *knew* it. Capt. Fryklund, responding, also looked ahead—to the day when the School would receive Canberras !

More About the Rotodyne

CONSIDERABLE interest has been centred on the Fairey Rotodyne since the announcement, last July, that a prototype order had been placed by the Ministry of Supply. Some additional details of this highly original project, which is strongly favoured as a contender for the "BEAline Bus" order, have now been published.

The two Napier Eland turboprops, providing tip-jet power to the main rotor for vertical flight and horizontal thrust for cruising, are stated to deliver 3,150 s.h.p. each. The four-bladed main rotor is of 90ft overall diameter; as previously announced, it is designed to autorotate during cruising flight. The span of the fixed wing, to which the underslung Elands are attached, is 47ft. Passenger capacity of the Rotodyne will be 40 people plus baggage, and the still-air range will be approximately 250 n.m. Its economical cruising speed, Faireys state, will be "not less than 130kt (150 m.p.h.)." The estimated operating cost over 100 n.m. is 27d per long ton/statute mile.

Bristol Helicoptery

LAST week we illustrated the prototype Bristol 173 Mk. 1 helicopter embarked in H.M.S. *Eagle* during a recent series of trials. These tests, which extended over three days, have provided the company with a full range of results of rotor starting and stopping behaviour, blade folding, striking down to the hangars and general handling in all conditions of wind. Mr. C. T. D. ("Sox") Hosegood, with three company personnel, took off from Gosport in the early morning to fly to the carrier, which was 50 miles offshore; the first landing was made with a deck wind of but five knots. Other members of the team included Mr. Raoul Hafner, chief helicopter designer; Mr. R. M. Howarth, assistant chief designer (helicopters); and Mr. K. Turner, chief flight-research engineer; they joined the ship independently.

With Trolley and Skids

THE second prototype of the S.N.C.A.S.E. Baroudeur trolley-launched fighter/attack aircraft is being completed at La Courneuve, where the fuselage was built, whereas the first prototype was assembled at Marignane, where wing and tail jigs are located.

It is learned that the order for a pre-production series recently announced was in general terms only, since price and quantity depend upon a governmental vote, which has not yet been put before the Chamber. Flight trials so far have proved satisfactory, and S.N.C.A.S.E. hope soon to make a demonstration tour of France, visiting towns with small airfields having no runway. Reports from Istres suggest that directional stability at landing (even in a considerable cross-wind) is excellent because of the high friction of the skid undercarriage.

Towards the end of November the Baroudeur was demonstrated to a mission from the Swiss Air Force and on that occasion, for the first time, a take-off was made from the skids and not from the trolley. To everyone's surprise, the run was shorter than ever before, suggesting that previous take-offs had been made without the assistance of rockets on the trolley.

Changes in Hawker Control

SEVERAL changes in the senior-executive organization of Hawker Aircraft, Ltd., are made concurrently with the appointment—announced last Friday—of Mr. A. N. Spriggs, O.B.E., M.I.P.E., as managing director of the two companies at Kingston-on-Thames and Blackpool.

Mr. J. T. Lidbury, J.P., succeeds Mr. Spriggs as general manager at Hawker Aircraft, Ltd., Kingston, and Mr. E. H. Jefferson, the present resident director, takes over as general manager at Hawker Aircraft (Blackpool), Ltd.

Mr. E. G. Rubython, former personnel manager at Kingston and later assistant secretary, becomes secretary in succession to Mr. Lidbury.

Mr. Spriggs and Mr. Jefferson have worked their way right up through the organization. Mr. Spriggs was with Sopwith Aviation, the company's predecessors, until they closed down, then went to work in the toolroom of the H. G. Hawker Engineering Co. in November 1920, later becoming foreman. During the succeeding years he won promotion to chief process engineer and became responsible for liaison with sub-contractors. In 1942 he was made general works manager of the Hawker group of factories. At this time, peak Hurricane production of 240 a month was achieved and, in recognition of his services, Mr. Spriggs was appointed O.B.E. He became deputy general manager in December 1942, was elected to the Board, and in December 1945 was made works director. Appointment to the post of general manager came in June 1951.

Mr. Jefferson started as an inspector at Hawkers in 1921; was promoted assistant chief inspector a year later; and became chief inspector in 1938. He progressed to the post of quality controller and in 1951 was elected to the Board as works director; he then moved to the new Blackpool works as resident director. He now relinquishes his title of works director of Hawker Aircraft, Ltd., but retains his seat on the Board.

Mr. Lidbury was appointed to the firm's secretarial staff in 1940, becoming secretary in 1948, and in 1951 he was elected to the Boards of the Hawker companies.

Mr. Neville Spriggs.

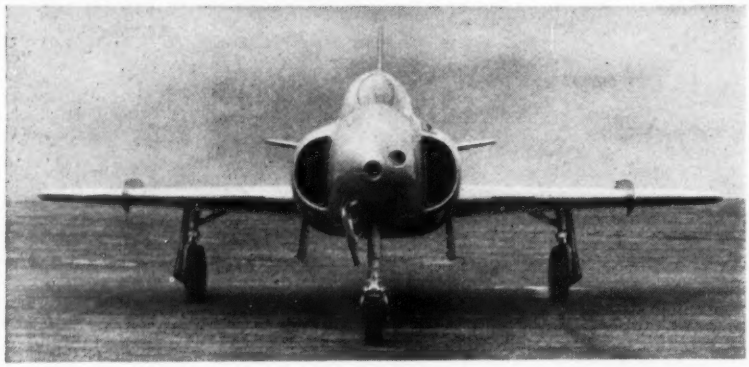
Mr. J. T. Lidbury.

Mr. E. H. Jefferson.

Mr. E. G. Rubython.

SPEEDY SPY: Now going into large-scale production is the Supermarine Swift FR.5 fighter/reconnaissance aircraft. This prototype is a converted Mk 1, and it can be seen that the lengthened nose has necessitated a taller fin of increased area. One camera is mounted in the extreme nose, flanked by the combat camera; lateral oblique cameras are covered by doors forward of the air intakes.

HERE AND THERE



M.R. Britannias for R.C.A.F.

THE Bristol Aeroplane Co., Ltd., announced last Monday evening that a decision in principle has been taken whereby units of the R.C.A.F. will be re-equipped with maritime-reconnaissance versions of the Britannia. The aircraft will be built by Canadair, Ltd.

. . . and a Canadian Directorship

INCREASING Canadian interest in Bristol engines has brought about the appointment of Dr. S. G. Hooker, O.B.E., A.R.C.Sc., B.Sc., D.I.C., D.Phil., F.R.Ae.S., F.R.S.A., as a director of the Bristol Aeroplane Co. of Canada, Ltd. He is a director of the parent company, and chief engineer of its engine division.

Reception for Canberra Crews

OVER 500 people attended the reception given at Londonderry House on Tuesday, December 1st, by Sir George and Lady Nelson, to welcome the crews of the Royal Air Force Canberras following their return from the New Zealand Air Race. In addition to representatives of the R.A.F., the Civil Service and the aircraft industry, members of the Diplomatic Corps, and representatives of the countries visited by the Canberras, were also present. An illustrated booklet describing the Canberras' participation in the race was presented to each guest. (A photograph taken at the reception appears below.)

The Morris Story

SHORTLY before Lord Nuffield's recent departure on his annual tour of his interests overseas, it was announced that he had been persuaded by a group of associates to permit the preparation of a biography, on the manuscript of which they have already been working for some time.

Verdin's Record Confirmed

THE world speed record set up on October 3rd last by Lt. Cdr. James B. Verdin has been confirmed by the F.A.I. at 1,211.746 km/hr (752.944 m.p.h.). The aircraft was the Douglas XF4D Skyray, and the record flights were made over the Salton Sea in California.

Guggenheim Medal for Lindbergh

THE Daniel Guggenheim Medal for 1953 is to go to Col. Charles Lindbergh; it will be presented at the honours-night dinner of the Institute of the Aeronautical Sciences in New York on January 25th. Col. Lindbergh was selected in recognition of his "pioneering achievements in flight and air navigation." Since his Atlantic flight of 1927, says the I.A.S., he has been active in planning civil air routes, has made extensive technical contributions to the aircraft industry, and during and since the war has served on numerous advisory missions to the U.S.A.F. and U.S.N. The first recipient of the Guggenheim Medal, in 1929, was Orville Wright.

Not-so-small Token

WHEN Mr. W. H. Bowker retired recently from the post of A.I.D. inspector in charge at Vickers-Armstrongs' Weybridge Works, after 40 years' service with the company, he was presented with a substantial gift—a carved oak sideboard. Mr. George Edwards, aircraft-division managing director, made the presentation.

Talking About Gliding

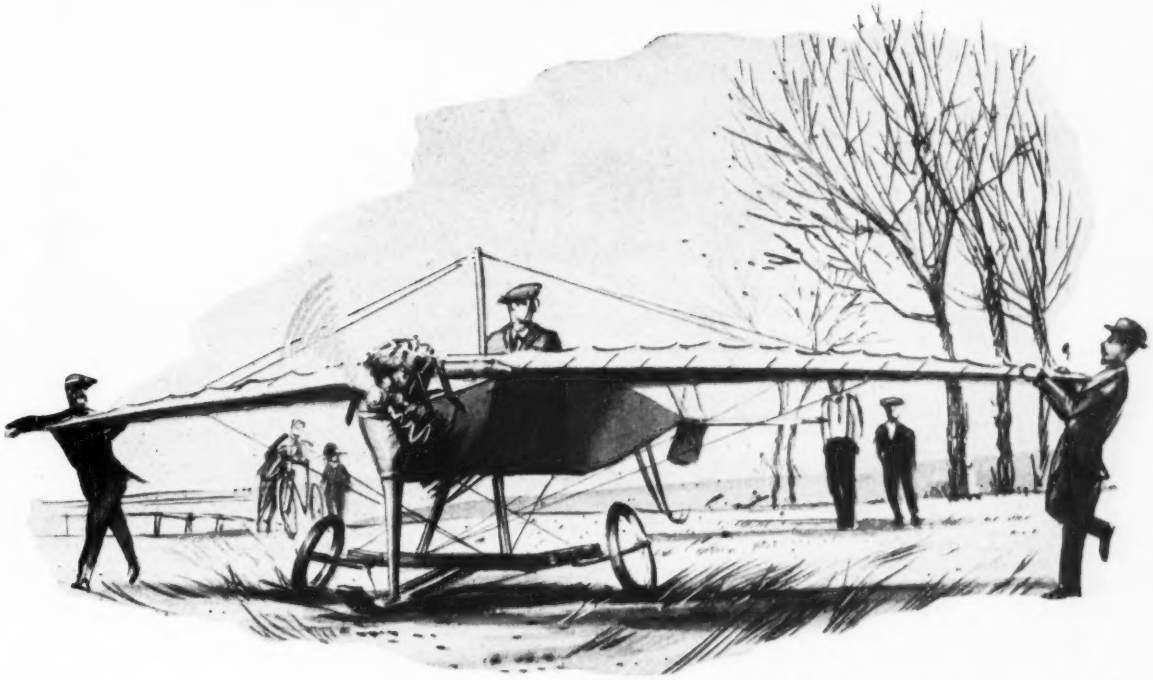
IN the B.B.C. Home Service programme at 9 a.m. on Wednesday next, December 16th, a talk entitled *Bird's Eye View* is to be broadcast. Describing a power pilot's introduction to gliding, it will be given by Ken Owen, of *Flight's* editorial staff, and is based on the experiences described in his article *Engines—Are They Necessary?* which appeared in our issue of October 9th.

The P.F.F. Ball

PATHFINDERS and their guests once again packed the ballroom of the Dorchester Hotel, London, last Saturday. Their enjoyable annual function goes from strength to strength as, incidentally, does the cabaret which follows supper. Among the official guests were senior officers of the R.A.F. Commands, artists of screen, stage and radio, and—particularly welcome—certain well-known test pilots and their wives. Congratulations are due once more to the organizers, F/L. (and Mrs.) Alex Thorne, and to the Pathfinders who responded so wholeheartedly to the festive opportunity.

SIR GEORGE AND LADY NELSON, at the Londonderry House reception referred to above, greet F/L. R. L. E. Burton, A.F.C. (pilot of the winning Canberra) and Mrs. Burton. Sir George is chairman and managing director of the English Electric Co., Ltd.

PIONEERS
—then and now



Blue Bird, the first Handley Page aeroplane, had swept-back wings, as have the modern supersonics.

HANDLEY PAGE

was the first limited liability company formed exclusively for the design and manufacture of aeroplanes.

In superpriority production, the new crescent-winged Handley Page Victor is the world's most efficient bomber.

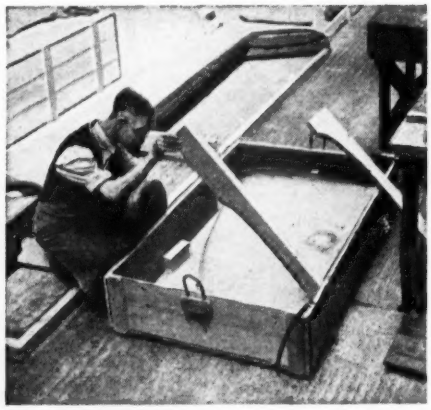
RADLETT LONDON READING

Careless torque costs...?

THE DANGER OF RIGID PACKING

Hitherto it has been accepted practice to pack large and delicate Aircraft Components—Wings, Fins, Elevators, etc.—in Cases or Crates fitted with felt-faced contoured timber formers. Rigidly fixed, these held the components so firmly that any distortion of the Case or Crate was directly transmitted to the packed component. Provided this distortion was not extreme, the container could return to normal, possibly leaving no indication that the component had been affected by torque.

THE OLD METHOD

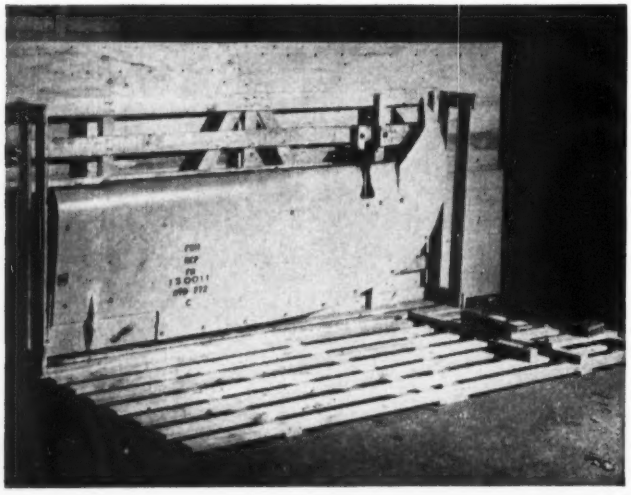


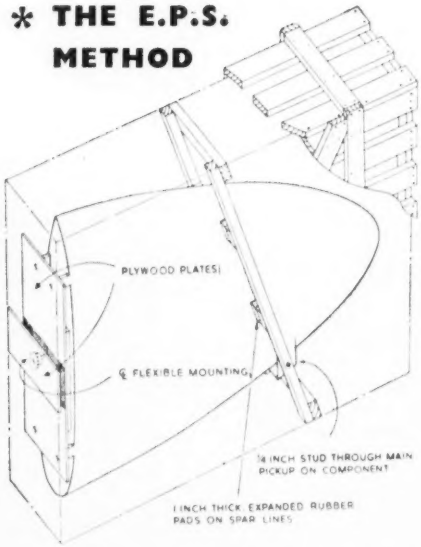
* 3-point suspension packing

Realising this danger and remembering that it is not possible to construct a timber container which will remain rigid under all conditions, E.P.S. have produced a packing process which caters for any reasonable distortion.

This process is generally known as 'Axial' or 3-point suspension packing. The E.P.S. principle is to insulate the packed component from any reasonable distortion which might be likely to occur. While securely protected by the outer container, the component, as it were, 'rides free' from any normal stress and strain.

*** THE E.P.S. METHOD**

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CIVIL AVIATION

SEVEN VISCOUNTS EARN £1.4m

CONFIRMING the provisional figures published in *Flight* a week ago, B.E.A. have just announced the results of the first six months of operating scheduled services with the Viscount. These results, achieved with an average fleet of seven Viscounts, cover the period mid-April to mid-October:—

Revenue flying hours	6,140
Passenger-miles flown	45 million
Revenue load-factor	76 per cent
Break-even load factor	51 per cent
Revenue earned	£1,400,000
Costs (including interest)	£1,005,000
Profit	£395,000
Profit per flying hour	£64

Such figures would be remarkable for any new airliner, but the Viscount also has the distinction of being the world's first passenger-carrying turboprop transport. The equivalent annual utilization, for example, works out at just over 1,700 hr per aircraft, which is more than the average for B.E.A.'s fleet—despite the teething troubles which afflict every new type.

SKYWAYS YORK INQUIRY

ON February 2nd this year an Avro York operated by Skyways, Ltd., disappeared over the North Atlantic while flying the Azores-Gander stage of its journey from Stansted to Jamaica. Last week the Ministry of Transport and Civil Aviation published the report of the public inquiry conducted by Mr. Roland Adams, Q.C., into the loss of the aircraft, its crew of six and its 33 passengers. Mr. Adams concludes that the outstanding feature of the inquiry is the lack of evidence as to what caused the disaster.

The aircraft, G-AHFA, was making a trooping flight for the War Office. It took off from Lagens Airfield at an all-up weight of 68,698 lb as against an authorized maximum take-off weight of 70,000 lb. Its Certificate of Airworthiness had been renewed only two days previously and the four Merlin engines had each run less than a quarter of their overhaul life of 1,000 hr. The crew members were properly licensed and experienced.

The Court found nothing remiss about the maintenance, loading or trimming of the aircraft; the fuel and oil reserves carried; the weather forecast; the navigation of the York; or the communications maintained.

To the Attorney General's question "Was the flight from the Azores to Gander a suitable operation to be carried out by a York aircraft in the prevailing weather conditions?" the Court made an affirmative reply.

The aircraft took off at 2325 hr on February 1st and its first Pomar (positional operational meteorological aircraft report) at 0010 hr the following day was followed by four further Pomars at intervals of approximately 1 hr.

At 0530 hr there was an urgency signal giving the position of G-AHFA, followed after a scarcely perceptible break by the distress signal "SOS, SOS, SOS, de G-A . . ." after which the transmission broke off abruptly. The facts that the final call was transmitted at greatly increased speed and suddenly broken off led to the conclusion that trouble developed in a sudden and violent manner. The bad ditching characteristics of the York made it unlikely that any survivor could have got out of the aircraft when it reached the surface . . .

The report mentions that on January 31st, while being towed by a tractor at Stansted Airport, the York was caught by a gust. The controls were not locked and the elevators were depressed so violently that the control column was forced out of the hands of the mechanic holding it and struck the blind-flying panels, breaking several instruments. The panels were removed and some instruments were changed; an unlicensed airframe inspector then made a thorough visual check of the complete elevator control run. The Court had no reason to question the thoroughness of this check and were unable to connect the mishap with the subsequent loss of the aircraft.

Although stressing that the cause of the accident was "undiscernible," the Court concluded the report with a number of recommendations which take into account some of the evidence given during the inquiry.

The major parts of the recommendations are quoted below:—

(1) Steps should be taken by all operators to review the maintenance discipline in and about hangars. . . . [a reference to the failure to ensure that the York's controls were locked.]

(2) Consideration should be given to the question whether it would be right to impose upon operators the duty of providing provisional schedules for the guidance of captains allowing for adequate periods of genuinely recuperative rest, the duration of which should be related to duty time and the circumstances of the flight. . . .

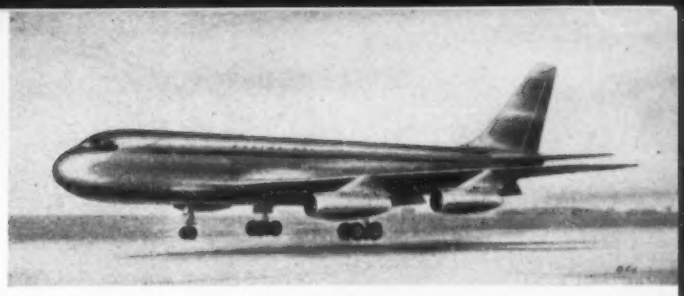
(3) The whole subject of crew fatigue should receive study at an impressive level. . . . It is for consideration whether a Departmental Committee should be set up to investigate this important subject.

(4) Consideration should be given to the desirability of strengthening or reinforcing Clause 40 of the "Compulsory Conditions" of Certificates of Airworthiness by imposing some limitation upon the permitted operation of an aircraft in terms of the degree and duration of icing to be expected.

(5) Oil-contents gauges, or some other reliable means of detecting loss of oil, should be made a mandatory requirement on all public transport aircraft.

(6) Study should be directed to the possibilities of transferring the contents of the methyl-bromide bottles from one adjacent engine to another.

(7) Consideration should be given to the problem of providing external stowage for a proportion of the dinghies carried . . .



A "Flight" impression of the Boeing 707 transport discussed below.

PAKISTAN MERGER

AMALGAMATION of Orient Airways, Ltd., and the new Pakistan International Airlines, for which Super Constellations have been ordered, is now in progress; the merger is expected to be retro-active from October 1st. At the request of the Pakistan Government, the air survey and safety division of the British Aviation Insurance Co., Ltd., recently completed a valuation of the assets of Orient Airways, who operate Convairs and Dakotas. The valuation, which involved over four weeks' study at Karachi and outstations, was conducted by B.A.I.C.'s Chief Technical officer, Mr. A. B. Hunter, with assistance from the company's Calcutta staff.

BOEING TRANSPORT FEATURES

PROGRESS with the Boeing 707 four-jet transport is reported to be on schedule. In the company's main plant at Seattle the first prototype—which will be a general-purpose demonstrator—now has its wing fitted, and it should fly, as planned, next June. The civil J57 engines are to be rated at about 10,500 lb thrust.

The Boeing 707 was described in detail in our issue of August 7th last. On this page is a *Flight* sketch of the machine showing a number of new features, such as the flush cockpit roof and windscreen and the bogie landing gear with a 21ft track, which is hinged on the rear spar and is housed in the fuselage when retracted. The number of cabin windows is remarkable and indicates that Boeing are being very cautious in cutting into the pressure-envelope. Each row of seats (assuming that such a window arrangement would be used on an airline-furnished 707) appears to be provided with two to three very small windows on each side of the aircraft. The design pressure differential is 8.6 lb/sq in; this compares with 8.25 lb/sq in for the Comet 1 and 8.75 for the Comet 3, both of which have much larger windows—elliptical in the case of the Comet 3, to save weight. There is, of course, the possibility of eliminating windows completely, but passenger reaction would certainly be unfavourable.

I.A.T.A. FARES: UPS AND DOWNS

AT the 18-day I.A.T.A. Traffic Conference in Honolulu, which concluded on November 22nd, representatives of the 70 member-airlines passed no fewer than 423 unanimous resolutions covering 30,000 rates and fares. Details were fixed of the final stage in introducing a world-wide network of tourist services by extending the present reduced fare levels to the trans-Pacific routes. Fares averaging 25 per cent below the first-class rate will be introduced from April 1st between North America and Australia and New Zealand; between Malaya, Siam, Hongkong and the Philippines; and between Japan and Korea. There will be no significant changes in the rates for the Western Hemisphere.

On the North Atlantic route, both first-class and tourist fares are to be increased slightly: a London-New York tourist return ticket, for example, will be increased from $495 (£177) to $522 (£186) and the first-class return fare on the same route goes up from $711 (£254) to $720 (£257). The cost of first-class travel on mid-Atlantic routes between America and Europe will be increased from October 1st next year, but tourist services will be introduced at the same time.

A concession to I.A.T.A.'s newest member, Hunting Air Transport, was the resolution providing for "special tourist" services between the North of England and Scotland and Scandinavia, at fares 10 per cent below tourist rates, in 28-seat DC-3s. It will be remembered that Hunting's attempt to introduce a Scandinavian network was blocked by I.A.T.A.

PILOTS' PARTY: Personalities at the annual cocktail party of the British Air Line Pilots' Association, held at Londonderry House on December 2nd: (top row) Three B.E.A. captains from Scotland—I. B. Scott, W. Fittall and S. Nicolle. The bearded B.E.A. helicopter pilot with Mr. John Profumo is Capt. R. W. Dibb. (Bottom row) B.A.L.P.A.'s chairman, Capt. J. Woodman, and secretary, Mr. D. Follows; on the right, Mr. A. T. Lennox-Boyd presents the first B.A.L.P.A. Gold Medal to Capt. T. H. Farnsworth of B.O.A.C. The award is discussed below.

B.A.L.P.A. GOLD MEDAL

RECENTLY appointed development pilot to the Britannia Fleet, Capt. T. H. Farnsworth has personally flown in the initial stages of development all but one (the Flamingo) of the types in service with B.O.A.C. or its predecessor since 1936. As illustrated above, he has just become the first recipient of the B.A.L.P.A. Gold Medal—an award instituted, largely through the inspiration of Capt. A. G. Lamplugh, to recognize long service to the pilot community. Capt. Farnsworth, who is chairman of the Association's air safety and technical committee, has flown 11,000 hr in over 40 types of aircraft.

CIVIL AVIATION . . .

earlier this year on the grounds that the rates were too low.

A similar concession permits "B"-class services between Cyprus and Khartoum. Although Skyways operate Colonial Coach services as far as Cyprus, no British company has applied to operate the Cyprus-Khartoum sector and the concession is presumably intended for Cyprus Airways.

The new fare-structure for the Eastern Hemisphere provides for increases on the majority of international routes, although in Europe increases on the short routes are offset by some reductions on the longer stages. The price differential between first-class and tourist fares remains at 15-20 per cent. The same differential applies to Europe-Africa fares, both grades of which are increased slightly; the cost of the London-Johannesburg single ticket, for example, goes up by £5. Both levels of fare are increased by about 10 per cent on routes between Europe and the Middle East, and tourist fares between Europe and India go up by some 5 per cent. There will be increases of up to 10 per cent on both tourist and first-class fares on various routes between Europe and the Far East. Within the Far East most of the first-class fares remain at their present level and the new tourist fares will be about 20 per cent lower.

IRISH VISCOUNTS

OUTLINE plans for operating the Viscount have been published by Aer Lingus. The four turboprop airliners ordered by the Irish airline, fitted out as 48-seaters, will take over nearly all flights between Dublin and London. They will also be used on the Dublin-Manchester-Amsterdam and Dublin-Paris routes. All four aircraft will come from the Vickers-Armstrongs production line at Hurn, which recently completed its first Viscount—the nineteenth of B.E.A.'s Series 701s. This aircraft—G-AMOO *John Oxenham*—is showing up particularly well in its initial flight tests.

S.A.S.-AEROFLOT AGREEMENT

AS the result of a recent meeting of representatives of S.A.S. and Aeroflot, the Soviet national airline, it is now possible for passengers to fly by S.A.S. to Helsinki and thence to Moscow, Leningrad and other points behind the Iron Curtain on a through ticket issued by the Scandinavian company. This arrangement, of course, applies only to passengers holding the necessary transit and entry visas.

Announcing the agreement, S.A.S. regretfully remind travel agents that "as yet" no commission is allowed by Aeroflot for travel on their lines. At a cost of £442 16s for a return ticket it is now possible for a passenger to fly from London to Peking. Three different airlines are involved: he flies from London to Helsinki by S.A.S., transfers to Aeroflot for the Helsinki-Moscow stage and completes the journey to Peking by Skoga, the Chinese airline.

BRITISH AIRPORTS IN OCTOBER

FIGURES published by M.T.C.A. for air transport movements at U.K. airports during October throw an interesting sidelight on the gradual process of transferring scheduled services from Northolt to London Airport. At the capital's No. 1 airport there were 4,100 movements during the month, an increase of 38 per cent over the October 1952 figure, and 118,000 passengers were handled—61 per cent more than in October 1952. At Northolt the number of movements decreased by 38 per cent to 2,200 and the number of passengers handled (45,100) during the month was 32 per cent less than in the corresponding month last year.

The trend towards the use of larger aircraft, and of high-density seating arrangements, is once again shown by the fact that air transport movements at all U.K. airports in October increased by only 7 per cent to 15,700, whereas the corresponding total of passengers handled (292,000) went up by 23 per cent.

BREVITIES

THE technical manager of Hunting Air Transport, Ltd., Capt. L. B. Greensted, M.B.E., was recently awarded a G.A.P.A.N. master pilot's certificate. Capt. Greensted began his aviation career in 1936 and his subsequent appointments have included that of chief test pilot to Rotol, Ltd.

* * *

Five days before the inauguration of American Airlines' non-stop transcontinental service with DC-7s, one of these aircraft set up a new airline record for the Los Angeles-Idlewild route by covering the 2,468 miles in 6 hr 31 min—an average speed of some 380 m.p.h. assisted by tail winds. On this proving flight 57 passengers were carried.

* * *

Both P.A.W.A. and T.W.A. have disassociated themselves from the report that an American airline has intentions of buying the Savoy Hotel, London.

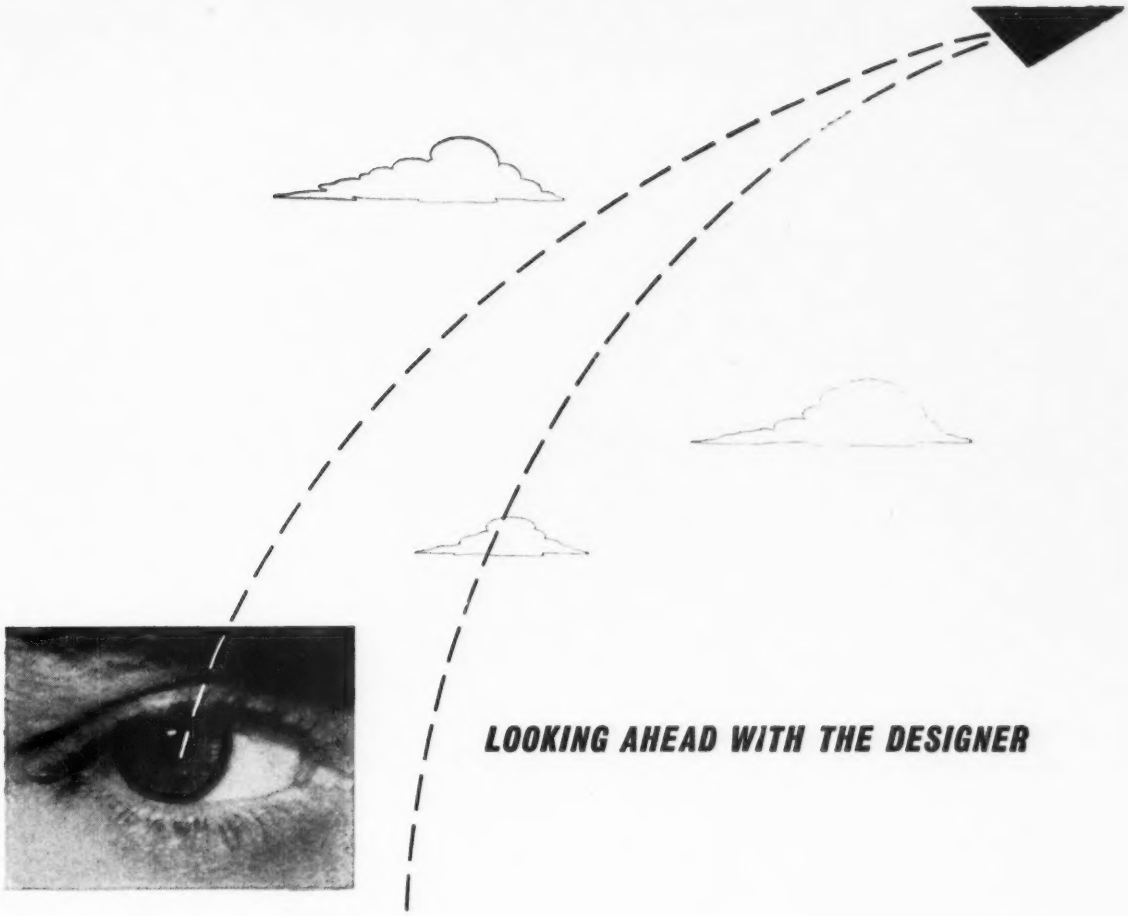
B.O.A.C. announce that a new Comet route—from London to Nairobi, Kenya—will be opened next April. Flights will be made twice weekly in each direction, with a call at Entebbe.

* * *

One of the eight Bristol 170s operated by the Spanish airline Aviacion y Comercio crashed into the Guadarrama mountains, about 60 miles from Madrid, on December 4th. The crew of four and six of the 29 passengers are reported to have survived.

* * *

Subject to government approval of the necessary dollar expenditure, Aerolineas Argentinas are to buy 15 Convair 340s. The new aircraft, together with five Convair 240s already in service, will presumably replace the 20 DC-3s operated by this important South American airline; no plans have yet been announced for replacing any of the long-range fleet of six DC-6s, six DC-4s and six Short Sandringhams.



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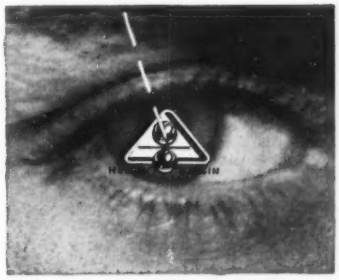

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SERVICE AVIATION

Royal Air Force and Fleet Air Arm News

Sir Basil Embry

THE *London Gazette* for December 1st announced the promotion of Sir Basil Embry, K.C.B., K.B.E., D.S.O., D.F.C., A.F.C., to the rank of Air Chief Marshal.

Sir Basil has been C-in-C. Allied Air Forces Central Europe since July 16th, 1953, and was previously A.O.C-in-C. Fighter Command.

Farewell Dinner

AT Bad Eilsen, Germany, last week, a dinner was given in honour of Air Chief Marshal Sir Robert M. Foster, C-in-C. 2nd A.T.A.F., who is retiring from the R.A.F. The principal guests were Sir Frederick Hoyer-Millar, the United Kingdom High Commissioner in Germany; his deputy, Mr. J. G. Ward; and General Sir Richard Gale, C-in-C. Northern Army Group.

The new C-in-C. 2nd A.T.A.F., Air Marshal Sir Harry Broadhurst, was due to take over from Sir Robert on Monday.

Minot Trophy Presented

AS recorded in *Flight* last week, No. 115 Sqn. paraded on December 4th to receive the Laurence Minot bombing trophy from Marshal of the Royal Air Force Lord Tedder, G.C.B., D.C.L., LL.D. The parade—held, because of the weather, under cover in one of Marham's expansive hangars—was before guests who included the Deputy Chief of the Air Staff, Air Marshal T. Pike, C.B., C.B.E., D.F.C.; the C-in-C. Bomber Command, Air Marshal G. H. Mills, C.B., D.F.C.; the A.O.C.s of Nos. 1 and 3 Groups, Bomber Command, A.V-M. J. R. Whitley, C.B., C.B.E., D.S.O., D.F.C., and A.V-M. E. C. Hudleston, C.B., C.B.E.; and the Commanding General of the U.S. 3rd Air Force, Maj. Gen. Griswold.

After inspecting the Squadron drawn up in review order, Lord Tedder made a speech in which he told of his first bombing operation carried out with No. 25 Sqn. in France in 1916. The FEs flew over enemy territory and dropped a series of bombs at random with the object of luring enemy fighters to action. Ever since then, he said, he had had "a complex on the subject of bombing." He felt that purpose and accuracy in bombing were vital and that peacetime practice in realistic conditions was indispensable in achieving that aim. The effectiveness of the small, but important, striking force in the R.A.F. today must be judged by its bombing accuracy. He regretted that the American bomber wing had not been able to drop sufficient bombs to take part in the competition and said that No. 115 Squadron's task might have been harder if they had. He then presented the Minot Trophy to S/L. L. G. Holmes, D.F.C., A.F.C., commanding No. 115 Sqn., after which he handed the Aircraft Servicing Efficiency Trophy, also won by Marham, to W/C. H. F. Cook, O.B.E., the Chief Technical Officer.

The Long Arm of Co-incidence

MORE than 150 people were present at the Goldfish Club's party and display in London on November 28th. One photograph, out of a total of over 50 pictures of wartime ditchings on show, was an enlargement of a photograph published in a German-controlled French newspaper. It was lent by Mr. H. C. Winter-Taylor, who, with the rest of his Whitley crew, was forced down 400 miles west of Cape Wrath in 1941. They were several days' sailing from any shipping lanes and were quite resigned to their fate when a U-boat surfaced alongside and took them prisoners. The photograph was taken by the submarine commander as the dinghy came alongside.

The guest of honour at the dinner was an American lady, Mrs. Banks Cornett, whose son, the late Capt. E. R. Herron, U.S.A.F., was made a member of the club after ditching his B-17 under particularly hazardous circumstances.

Hack Trophy

WITH a marking of 85 per cent, Leeds University Air Squadron has been awarded the Hack Trophy for 1953. Second was Queen's U.A.S., Belfast, with 78 per cent; Liverpool U.A.S. was third with 77 per cent.

R.A.A.F. Malayan Awards

FOR his work as deputy bomber leader and master bomb-aimer with No. 1 Squadron, Royal Australian Air Force, in Malaya, F/S. E. R. Cheney has been awarded the Distinguished Flying Medal. Sgt. L. Daly has been awarded the British Empire Medal and F/O. A. J. Cook and W/O. A. W. Messell are Mentioned in Despatches; they, also, are members of No. 1 Squadron, R.A.A.F.

Fleet Air Re-arming

GOOD progress is being made in re-equipping Royal Naval fighter squadrons. The standard first-line fighter, the Hawker/Armstrong Whitworth Sea Hawk, already equips Nos. 806 and 898 Squadrons at Brawdy, and No. 804 is converting at Lossiemouth. Early next year other units will receive the aircraft, beginning with No. 802 Squadron.

The last-named unit will convert direct from the piston-engined Sea Fury; Fury-equipped R.N.V.R. squadrons will convert to the Sea Hawk by way of the Attacker, which will soon be a second-line machine. The D.H. Sea Venom is also being issued to squadrons, generally to replace the Sea Hornet. Most of the new re-equipped squadrons will be embarked next year.

R.A.F. Fund's Expenditure

THE controller of the R.A.F. Benevolent Fund, A.V-M. Sir John Cordingley, has announced that the expenditure of the Fund since the end of the war on relieving distress among serving and ex-Service R.A.F. and W.R.A.F. personnel and their dependents has now exceeded £5,000,000.

Sir John said that the continued gap since the end of the war between income and expenditure was causing serious concern. During the first nine months of this year the Fund has spent £439,177 in helping 16,566 cases in Great Britain, Northern Ireland and overseas.

A.O.P. Efficiency Trophy

FOR the third year in succession, No. 663 A.O.P. Squadron, R.Aux.A.F., has won the Air Observation Post Efficiency Trophy. The unit is commanded by Maj. C. Surgeon, R.A., and is based at Hooton Park, Cheshire.

OVERWEATHER FORMATION: Nine Meteor 8s of No. 65 Squadron escape from East Anglia's mists by practising "line abreast" above the clouds. A short history and further photographs of the squadron will later appear in "Flight".

COMET DEVELOPMENT

AS the time for delivery to B.O.A.C. of the first Comet 2s draws near and construction of the prototype Comet 3 proceeds (for a first flight next year), more information has become available with regard to performance and important design-details. Progress with certain design developments for the Comet 3 has been such that some items which would also benefit the Comet 2 are being phased-in on the production line. In addition, other improvements which on a time-estimate basis had been visualized for later production Series 2s will now be incorporated from the beginning.

Principal feature under this heading is the new wing section, which incorporates an improved leading edge. The effect is to give the wing more camber and higher maximum lift. This modification was first tried out on the prototype Comet 1, G-ALVG, as long ago as December 2nd, 1952.

Some figures associated with the new leading edge show that, where a take-off weight was previously restricted by runway length, 2,400 lb can be added—all payload in practice—for the same conditions and performance. The required landing run is also reduced by about 11 per cent. On the Series 2 the combination of more power from Avon turbojets and the new leading edge make it virtually impossible to stall the wing on the ground. It means, in practice, that at full load the Comet could accelerate and fly off in any attitude attainable up to the limit with tail bumper scraping on the ground (picture, p. 747). This has been proved by actual trials and a remarkable ciné record has been obtained.

It is now known that Comet 2s will enter service with 7,000 lb thrust Avons and an a.u.w. of 120,000 lb. They will have 7,000 gallons fuel capacity, all internal. Comet 3s will have more powerful Avons and additional tankage.

Other improved features to be found in the Comet 2 are Maxaret brakes and a rearrangement of the eight-seat front cabin. Automatic engine synchronization is also planned for future Comets. It is presumed that all or any of these new or improved features could be incorporated in retrospect on Series 1s.

Carrying its capacity payload of 13,750 lb with full allowances and cruising at a speed of 450-490 m.p.h., the Comet 2 will operate a stage-length of 2,250 miles. Allowances are severe: stage flown against 50 m.p.h. wind; 5 per cent fuel; 1½ per cent navigational tolerance; 200-mile diversion from sea level at destination; thirty minutes' stand-off at 1,000ft, and in addition a 1,000 lb arbitrary fuel margin (B.O.A.C. allow 2,200 lb for this).

On both the Series 2 and 3 the new fixed-droop leading edge brings with it a slightly different shape for the main air intakes. The 3 will also have large oval single-pane windows, taking the form of inscribed elipses in the present rectangular window; this aircraft will have a pressure-differential of 8¼ lb (the figure for the Series 1 and 2 is 8¼ lb) and the oval windows, even stronger and lighter than the rectangular ones, have been tested to over 200 lb/sq in—a safety factor of 25. Larger flaps will take care of the higher wing-loading and the trailing edge will appear straighter.

Other Comet items include the news that three Series 2s have flown, and that a fourth—with production-type leading edge—is almost ready. In all, thirteen are in an advanced stage of assembly, and Avons are grouped about ready for installation. B.O.A.C. will soon have two Series 2s for trial and training. Provision will be made for tail parachutes, strictly for emergency use on the Series 3, and on request the 2s could be likewise provided. Noise in the 2 is similar to that in the 1s at the rear end of the cabin, but quieter in front, where the compressor whine is no longer apparent.

Braking is considered quite adequate with Maxaret, but experiments have been going on with reverse thrust as a general D.H. research matter. At this early stage this work is described as "looking promising."

That refuelling presents no problems is indicated by the latest U.A.T. turn-round and schedule times on their Paris to Johannesburg services. The longest time on the ground is 33 min and the elapsed time is 16½ hr, of which 15 hr is in the air.

During our recent visit to Belfast in connection with the demonstration of the Short Sherpa (the description appears below), we were able to take a look at progress on the Short production line for Comet 2s. Fifteen are on order at present and the first is well advanced. It is expected to be completed at about the same time as the Sydenham runway extensions (to give 2,000 yards), namely, in March next year. Several other Comets are represented by large assemblies in the jigs and a variety of components.

THE SHERPA DEMONSTRATED

LAST Friday the Short Sherpa S.B.4 research aircraft made its public début at Aldergrove airfield, Northern Ireland. Mr. Tom Brooke-Smith put it through its paces in a wholly convincing manner and left no doubt as to its adequate stability. Perhaps "paces" is a rather inappropriate term, for the Sherpa is no more than a small powered glider—it has two Turboméca Palas jets—built as a private venture to prove the isoclinic wing.

The design combines several unorthodox features—it is semi-tailless, with 42 deg 22 min swept wings, and incorporates a control system by rotating wing-tips—so practical flight experience was essential. This the Sherpa can begin to provide. In particular it has in its first ten hours established that fore-and-aft stability is good over its as yet small speed range. The present limitation of 130 kt will be lifted after resonance testing, and the Sherpa will then provide further control and stability data up to about 250 kt in a shallow dive. Although it has no horizontal tail surfaces the Sherpa is equipped with effective flaps.

The chief test pilot stated that if another pilot were put into the Sherpa cockpit and allowed to fly without knowing what aircraft he was in, he would have no way of telling by the feel and response of controls that he was not in a good conventional elementary trainer. Anyone who expected to see a suggestion of pitching on initial climb or during the very slow and low high-incidence fly-past were disappointed. The Sherpa (new picture, p. 746) looked completely steady down to very low speeds.

The linkage of the stick to the wing tips to give both aileron and elevator effect is very simple and straightforward. The extent of the angular movement of the wing tips or elevons is greater than we had supposed. Fore-and-aft stick produces: up, 5 deg; down, 17½ deg. Lateral use of the stick gives up or down 9 deg. Combined use (i.e. oblique stick): up, 9 deg; down, 26½ deg. The elevons are hinged or pivoted so as to be as nearly as possible balanced aerodynamically in flight. They carry a small geared anti-balance tab which is electrically adjusted.

The wing is built of wood with ply covering for quick economical construction. It may be recalled that the torsion box is behind the spar and that a spanwise slot from root to tip kills torsional stiffness in the leading-edge portion. The wheels, tyres and brakes —the complete assemblies in fact—are Palmer products as designed and fitted on the Percival Provost. Well proved on this basic trainer, they were most suitable for adoption on the Sherpa. The shock-absorber units are by British Messier. The Palmer Tyre, Ltd., also make a special inching control for the flap-operating ram. The pilot may select 60 deg of flap for approach and, just before levelling out, the flaps move automatically to 80 deg for touch-down, so acting as effective air brakes.

For high-speed, high-altitude trials of the isoclinic wing a more advanced aircraft will be required; powered controls would presumably be fitted. No order for such an aircraft has yet been received, and the cost to continue with a new aircraft without a research contract would be beyond Short's own resources. Decisions must be taken in the near future as to the promise and application of the aero-isoclinic wing for high-altitude, long-range aircraft which require also to manœuvre and to fly fast at low altitudes. The timing of the design is such that to delay placing a contract if one is deemed to be justified and the money can be found would be to damn the project at birth.

There is about seven years of background thought behind the wing design and two years' actual work on this machine. We may here remind readers that the designers of the swept, high-aspect ratio wing—Short's, together with Mr. Keith-Lucas (their chief designer) and Professor Hill as the originator of the basic idea—list its aerodynamic advantages and those of the associated rotating tip controls (in effect an all-moving tail on the wing tips) as:—(i) no elevator reversal; (ii) no aileron reversal; (iii) no tip stalling; (iv) no adverse aileron yaw; (v) no rolling moment (l/v change) due to speed and incidence.

The Sherpa, incidentally, will also provide Blackburns with experience of Turboméca Palas operation.

After the Sherpa demonstration we were able to take a brief look at the impressive and well-equipped Short factory at Queen's Island, Belfast. The floor area is 1¼ million square feet, and surrounding facilities include a good airfield with excellent approaches to the main runway, a deep-water berth alongside for aircraft carriers and other craft, and a fine natural flying-boat base. Canberra production is in full swing; Comet 2s are well under way, the first being due in about 2½ months time; many Sunderlands are being rebuilt and re-equipped, and the Sea Mew is under intensive development. Supporting Short factories are situated at Newtownards, Castlereagh and Lisburn.

Powered by an Armstrong Siddeley "Double Mamba"

THE Royal Navy, which has to maintain sea communications, regards counter-measures to the submarine threat as of first importance. Much of the new anti-submarine equipment is specialised, and demands unique capabilities and characteristics from the aircraft employed. To cover this feature of defence the Fairey Gannet is in super-priority production, and has also been ordered for the Royal Australian Navy.

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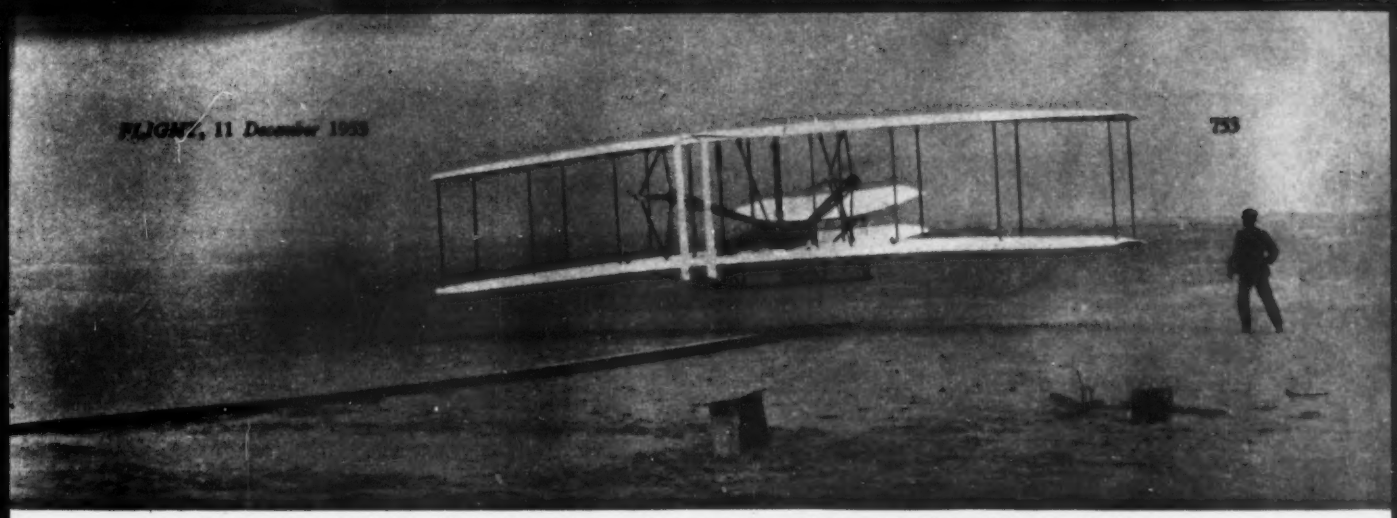


1 *The first authenticated powered flight—from a plate negative in the Wright collection of the Library of Congress, Washington.*

THE FIRST FIFTY YEARS

By H. F. KING, M.B.E.

THIS is the tribute of one British journal to two American brothers.

Originally it was to have formed a sort of aeronautical hall of fame; but the idea was quickly discarded in the realization that famous aircraft are not necessarily significant in a technical sense. Next it was felt that our space might be devoted to technical innovations of the past fifty years; but as a gallery of freaks threatened to result, this notion, too, was abandoned. Then a technical museum on paper suggested itself—and was rejected because an academic approach seemed inappropriate at this time, when the romance of flying is foremost in our thoughts.

Finally, we determined that our pages should be transformed, as it were, into Elysian Fields of the air, wherein the reader might browse among the truly great or otherwise worthy machines of the first half-century of powered flight; and upon this determination we acted by ransacking the *Flight* archives.

Among the pioneers, the bread-winners, war-winners and trophy-winners will be discovered here some odd "one-offs" which, though they may have achieved only an obscure flutter, yet contributed something worth while to design or to the art of flight. There are examples, too, which were built for (and gave nothing more than) pleasure.

Around this motley company is told a story wherein adventure, doggedness, courage and failure are met and re-met—but overall a story of glorious success, the measure of which may be gauged by turning directly to page 786.

Part 1 The Peaceful Years (1903-1913)

1903 At half past ten on the morning of December 17th a winter gale was scouring the levels near Kill Devil Sand Hill, Dare County, North Carolina, U.S.A. A frail biplane, supported 8in from the ground by a trolley on an iron-shod wooden launching rail, shuddered in the gusts. Orville Wright took his position prone behind the frontal elevator, the 12 h.p. engine was started, the retaining wire slipped, and the machine thrust itself gradually forward and lifted from the rail to a height of eight or ten feet. Wilbur Wright ran alongside to lend a steadying hand. Ground speed was 10 m.p.h., air speed 30-35 m.p.h.

The flight—the first of four that day—was a short one; but it was the very first authenticated flight by a power-driven, heavier-than-air machine. Its commencement is recorded in the dramatic photograph reproduced above—the most famous ground-to-air picture ever taken.

1904 With a larger machine of 16 h.p. the Wrights worked on at Huffman Pasture, near Dayton, Ohio. A public demonstration in a dead calm, and with a troublesome engine, failed to impress; but the brothers persevered, and on November 9th Wilbur completed nearly four circuits of an 80-acre field in 5 min 4 sec.

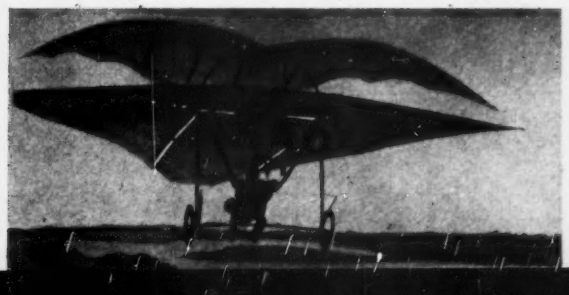
1905 On October 6th of this year a still larger Wright biplane flew 24¼ miles in 38 min 3 sec.

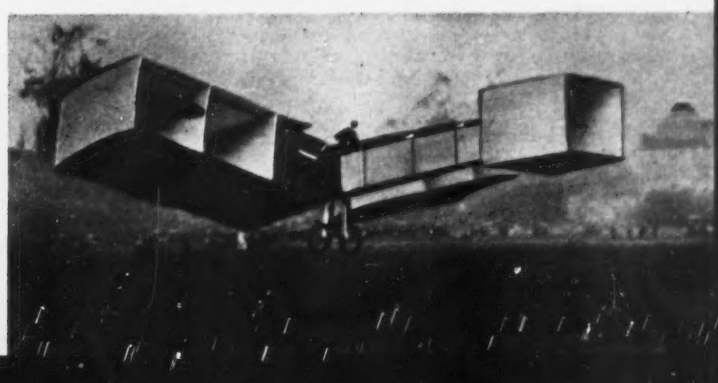
1906 The Wrights did not make a single flight during this year though they were developing a new engine with vertical, instead of horizontal, cylinders. On September 12th the Dane Ellehammer (2) contrived to remain out of contact with the island of Lindholm for a distance of 137ft, and in France, on October 23rd, the mercurial Brazilian Santos Dumont kept aloft for 25 metres in his 14 *bis* tail-first biplane (3), thus winning the Archdeacon Cup for the first flight in Europe. Later he made the first installation of ailerons on his machine, as shown.

1907 A pioneer pilot of the Voisin-type biplane (5), constructed during 1907, was Henry Farman, an Englishman domiciled in France. The Frenchmen Louis and Jacques Bréguet, in association with Charles Richet, made the first vertical take-off during this same year in their helicopter (4), though Paul Cornu, a contemporary, forestalled them in being "first off the ground" in a rotary-wing machine.

1908 In March, Léon Delagrange carried the first passenger on a heavier-than-air machine; he was his fellow Voisin pilot, Henry Farman. The biplane *v.* monoplane controversy was warming up, with Blériot and Robert Esnault Pelterie as exponents of the latter. Glenn Curtiss and his confrères on the American/Canadian Aerial Experiment Association won the *Scientific American* Trophy with their June Bug (6), and the Wright biplane, which Wilbur brought to France, amazed European observers. Cross-country flights were gingerly undertaken during this year (Henry Farman flew some 17 miles between Châlons-sur-Marne and Rheims in 20 min during October); but Wilbur

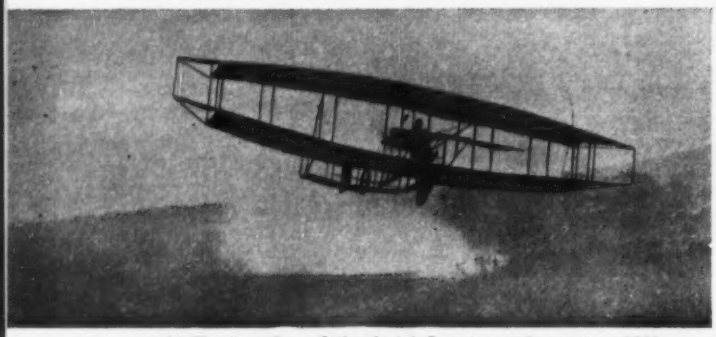
2 *(Below) Biplane of the Dane Ellehammer, as reconstructed during 1907.* 3 *(Right) The tail-first 14 bis of Santos Dumont (1906).*





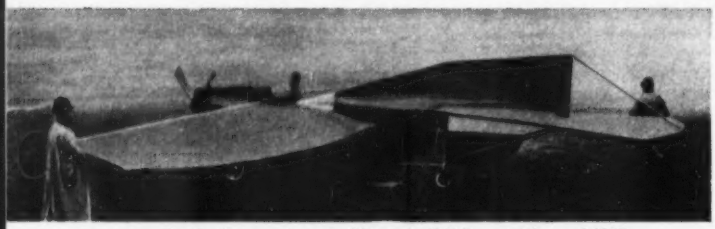
4 *The Bréguet-Richet helicopter was airborne in 1907.*

5 *Henry Farman's Voisin biplane, 1907.*

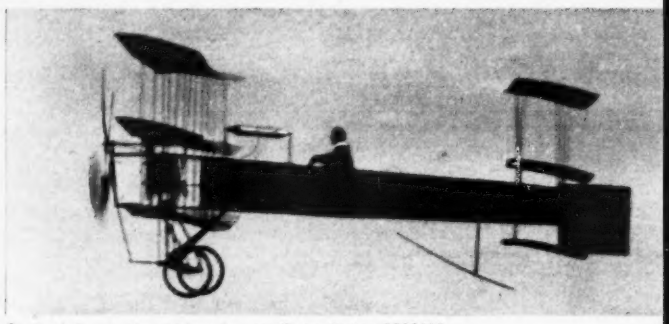


6 *The June Bug of the Aerial Experiment Association, 1908.*

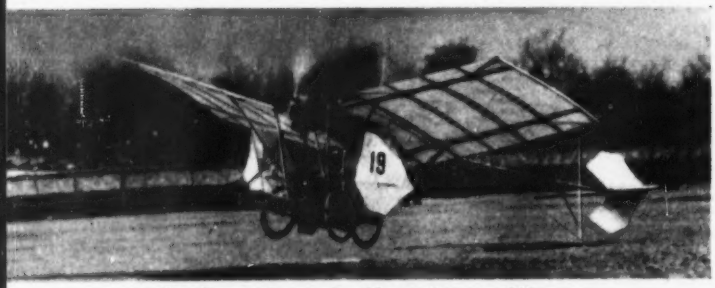
7 *An Antoinette monoplane of 1909.*



8 *Striking modernity of line: the R.E.P. monoplane of 1909.*



9 *A. V. Roe in the triplane he was flying during 1909/10.*



10 *The tiny Demoiselle of Santos Dumont, 1909.*

THE FIRST FIFTY YEARS . . .

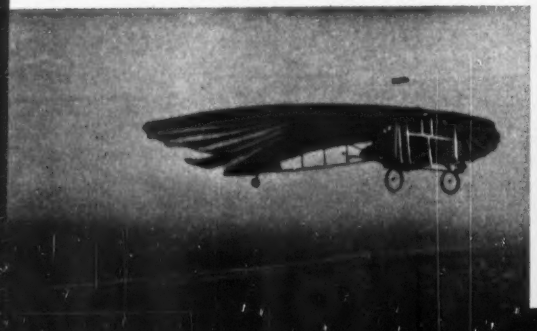
Wright really "showed how" on New Year's Eve by covering about 93 miles in 2 hr 20 min 23 sec. By the end of 1908 Louis Blériot had built a number of machines, including some monoplanes of very clean lines; but his bright star was not yet firmly in the ascendant. Cody and Dunne were active in England.

1909 This was a golden year and is now most widely associated with Blériot's Channel crossing of July 25th, in his No. XI monoplane (**12**). (Equally widespread, perhaps, is the belief that Blériot's was the first air crossing of all, though that had been accomplished in January, 1785, by the balloonists Blanchard and Jeffries.) Blériot's feat was at once a magnificent sporting effort and a sombre portent for us in Britain.

At the famous Rheims meeting in August, Henry Farman stayed up for 3 hr 4 min 56 sec; Glenn Curtiss, in his little biplane, flew at nearly 50 m.p.h.; and the Frenchman Latham (who valiantly, but unsuccessfully, attempted to cross the Channel before Blériot) climbed to just over 500ft in his Antoinette. J. T. C. Moore-Brabazon, in a Voisin, became the first Englishman to fly in his own country, and A. V. Roe was to be seen at Lea Marshes (and later at Wembley) in his tractor triplane (**9**). Horace and Eustace Short were making Wright biplanes at Shellbeach, and Santos Dumont introduced his tiny Demoiselle—the world's first "light aeroplane" (**10**). In Europe and America numerous amateur and professional constructors were building—and sometimes flying—their monoplanes and multiplanes. The Austro-Hungarian Etrich, for instance, was active with a monoplane (**11**) which was a forerunner of the later Taubes of the German Air Force. Other 1909 monoplanes of "modern" concept were the Antoinette (**7**) and the R.E.P. of Robert Esnault Pelterie, which was partly of welded steel construction (**8**). The basic R.E.P. design dated from 1907.

Among the variegated range of engines used up to this time (A. V. Roe had flown his triplane with a J.A.P. of only 9 h.p.) the Antoinette had been among the most successful, but during 1909 the 50 h.p. Gnôme rotary was fast establishing itself as the pre-eminent power unit—one, indeed, which was to exercise a very marked influence on aircraft development by virtue of its compactness and attractive power/weight ratio. The Bréguet and Howard Wright biplanes, shown at Olympia, were made of steel tubing. Flying boats were unsuccessfully essayed by the German Major von Parseval (famed for his airships) and the Englishman Humphreys, and on October 22nd the first woman pilot—Mme. la Baronne de la Roche—flew solo.

11 *(Below) Etrich monoplane of 1909.*
12 *(Right) Blériot's No. XI, one of the most famous aircraft of all time.*



1910 That the edifice shown in Fig. **14** (the Henri Fabre seaplane) could possibly fly, or even float, is difficult to believe; but on March 28th, 1910, it succeeded in rising from, and returning to, the water, so becoming the first powered seaplane to accomplish these feats.

In France, too, the Farman "box-kites," exemplified by the specimen at **13**, were flying from strength to strength, establishing a classic type which was to give years of splendid service in, and be imitated in, many countries. Less conventional was the tailless biplane of the Englishman, J. W. Dunne (**15**), one of a series of such machines designed for, and achieving in a large measure, "automatic" stability. The type was subsequently built in America as the Burgess-Dunne. Another precocious concept was the Coanda biplane (**17**), with its ducted-fan type of turbine power plant and in which Mr. Coanda (who later designed for the Bristol company) believes that he "took off for a few feet, then came down hurriedly and broke two teeth."

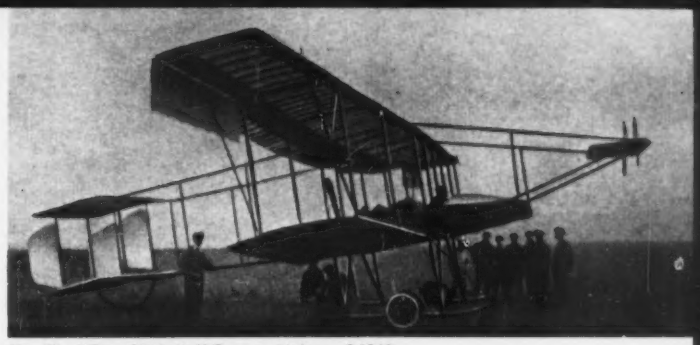
The bluff, picturesque, American-born "Colonel" Cody, who had made the first official powered flight in England on October 5th, 1908, built appropriately bluff and picturesque aeroplanes. This is borne out by the picture (**18**) of his 1910 Cathedral. A later development won the Military Trials of 1912.

Exemplifying the efficiency of the French Bréguet biplanes of this period, represented in Fig. **16**, was the *Coffee Pot*, which carried six people in August 1910. During the following months Bréguet was to introduce a biplane which was not only of metal construction, as were earlier models, but had an oleo undercarriage and a geared radial engine.

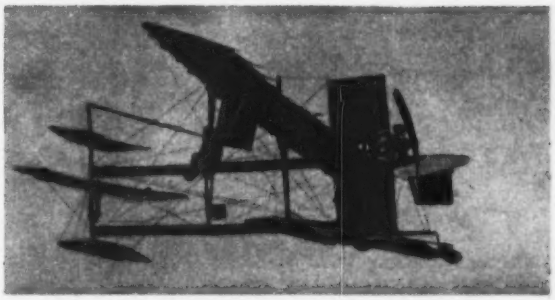
1911 The choice selection of types which illustrates this year does not include the classic Avro tractor biplane, for this will be represented later by the illustrious, and incomparably successful, "504."

Not wholly successful, but interesting in being a true web-footed duck, was the Voisin *canard* (**19**) which, according to a contemporary account, could be "used on the water, on the road or in the air." Here, then, we have not only the first amphibian but the first "roadable" aircraft also, and, moreover, the first to have a retractable undercarriage.

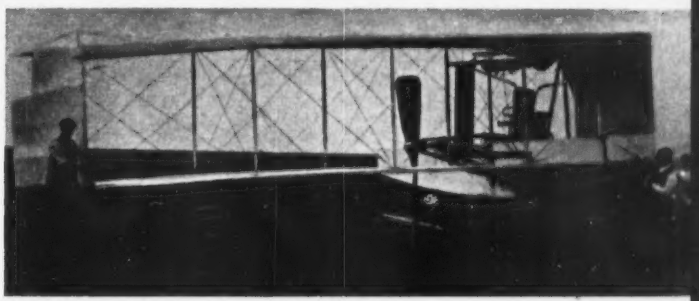
A significant pointer to a formula which was to succeed only after many years (though not successful in itself) was the astonishingly clean Antoinette military monoplane (**20**). The cantilever wing and "trousered" tandem-wheel undercarriage may be seen; but invisible is the steam-cooled direct-injection engine. An astonishingly portentous effort, and one which was to be echoed by American Northrops of the 1930s.



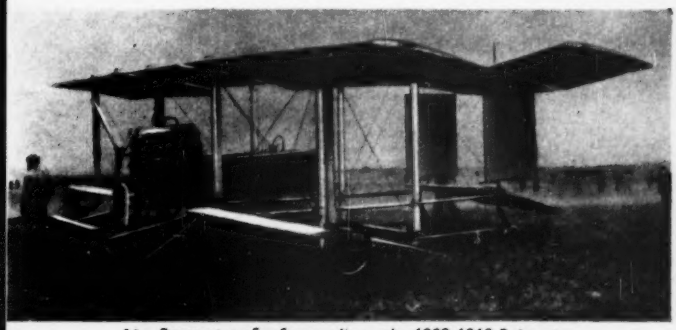
13 *The "Type Michelin" Farman biplane of 1910.*



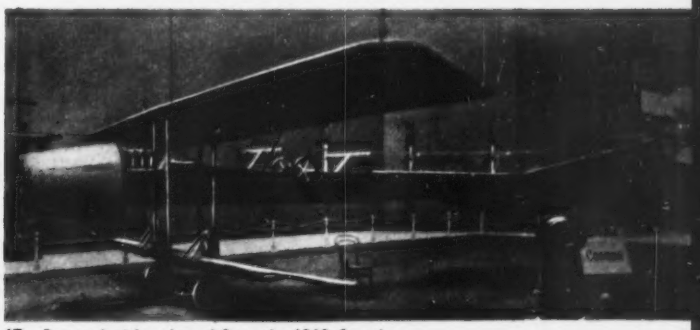
14 *The incredible Fabre seaplane which flew in 1910.*



15 *A 1910-model tailless Dunne, with twin propellers.*



16 *Progenitor of a famous line—the 1909-1910 Bréguet.*

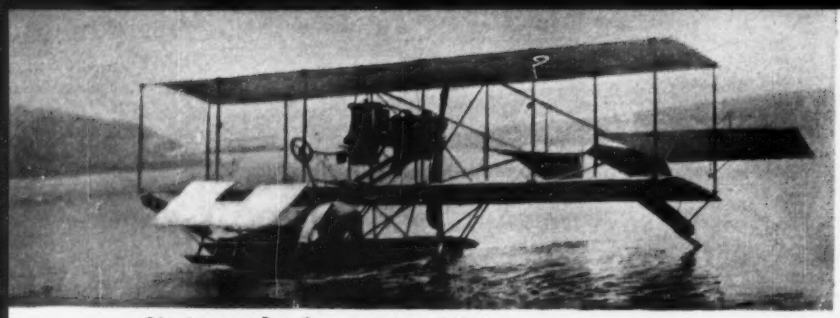


17 *Powered with a ducted-fan—the 1910 Coanda.*

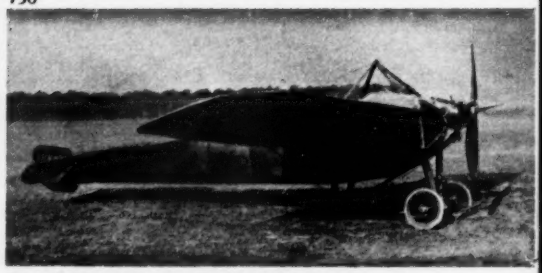
18 *"Colonel" Cody's massive Cathedral, 1910.*

19 *This Voisin amphibian was flying in 1911.*

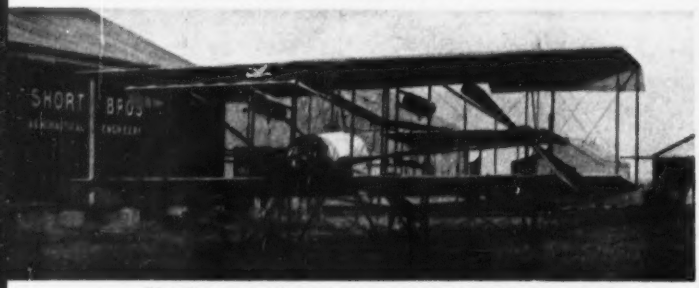
20 *An altogether amazing machine—the 1911 military Antoinette.*



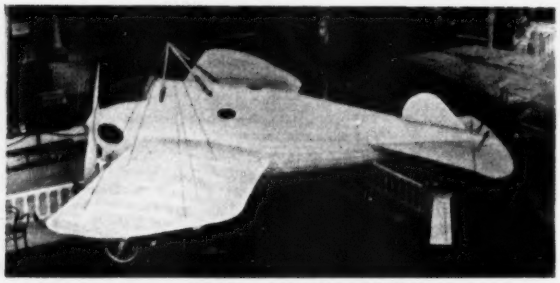
21 *A central-float Curtiss seaplane of 1911.*



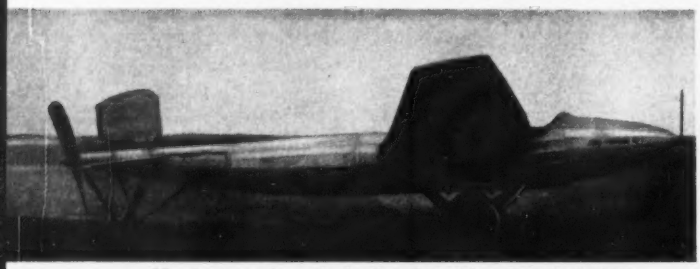
22 *Clean and sturdy—a 1911 Nieuport.*



23 *Twin-engined, triple-screw—the Short Triple Twin of 1911.*



24 *Showing the way—the Piggott monoplane of 1911.*



25 *A trim pusher—the Paulhan Tatin "Aero-Torpille," 1911.*

26 *A military biplane from Farnborough—the 1911 B.E.1.*

THE FIRST FIFTY YEARS . . .

(**1911 Cont.**) Though, strictly speaking, Glenn Curtiss's "hydro-aeroplane" (**21**) was a central-float seaplane, the germ of the flying-boat idea was there, and in 1912 there followed the true Curtiss boat which was to influence designers the world over.

Despite the continued popularity of "box-kites" of Farman pattern several designers already had an eye to aerodynamic refinement. The French constructor Nieuport, for instance, who had built his first monoplane in 1909, was developing his clean-cut, sturdy, deep-bodied design (**22**), and even cleaner were the British Piggott enclosed monoplane (**24**), which did not fly, and the pusher Paulhan Tatin (**25**). This last was a more successful design and its essential features were to reappear in the Douglas XB-42 high-speed bomber of 1944.

Multiple power plants were now coming into the picture, and we illustrate at **23** the Short Triple Twin, built in the summer of 1911 and having two 50 h.p. Gnômes mounted in tandem, the front one driving, through chains, a pair of tractor screws, and the rear one coupled direct to a propeller. Almost simultaneously Shorts completed their Tandem Twin, in which the engines were similarly arranged, though the chain-driven airscrews were replaced by a single direct-driven tractor. A third multi-engined development, of 1912, was the Triple Tractor.

At the Army Aircraft Factory, Farnborough, Hants, F. N. Green and Geoffrey de Havilland designed the B.E.1. (**26**) which, early in 1912, was to receive the first British Certificate of Airworthiness. Therein the mean speed, over a ½-mile course "with a live load of 25 stone and sufficient petrol for one hour's flight," was certified as 58-59 m.p.h. The B.E.1 was the forerunner of the much maligned B.E.2C and its derivatives, which were good aeroplanes in their day. And if that day lasted overlong it was no fault of the designers.

1912. The most exacting competitive tests to which a group of aircraft had ever been subjected at the time were the British Military Trials, conducted on Salisbury Plain during 1912. There were entries by Avro, Bristol, the Coventry Ordnance Works, Piggott, Cody, Vickers, Martin Handasyde, Handley Page, Deperdussin, Hanriot, Blériot, Borel, Lohner, Bréguet and Farman, and the engines ranged from a 35 h.p. Anzani to the 120 h.p. Austro-Daimler installed (with a hand starter) in the victorious Cody biplane. Among the monoplane entries were two Bristol/Coandas of new design (**27**) and on this same type of machine an installation of wheel brakes, operated from the rudder bar, was eventually made. Bristol/Coandas were exported in some numbers and were among the first aircraft to be used on active military service. A biplane of the same parentage, shown at Paris in 1913, had a bomb-dropping device containing twelve bombs which could be released at any desired interval by means of a lever in the observer's cockpit. We read (with some concern) that this early bomber was fitted with "a pair of sights by means of which the machine may be kept on a certain course when headed for a landmark such as a church tower."

Avro's entry for the Military Trials was a cabin biplane, and this had a monoplane counterpart in the machine shown at **28**. Reviewing this monoplane in October, 1912, *Flight* observed: "Two other enclosed-body machines have been built, but they can scarcely come under the same category—the 100-h.p. Blériot *berline*, for the pilot was accommodated outside the four-seated carriage-built body, and the Piggott monoplane, a British machine, for the fact that it has since the Aero Show of 1911 been modified, so that the pilot's head is outside the body of the machine. Thus, distinction attaches to those responsible for the monoplane under review, to the Avro firm for being the first to produce a machine of this type to prove itself successful in appreciably long flights." Long-winded, but fair comment.

27 *Built for the Military Trials of 1912, the Bristol/Coanda monoplane.*

28 *The first successful cabin monoplane, by A. V. Roe in 1912.*

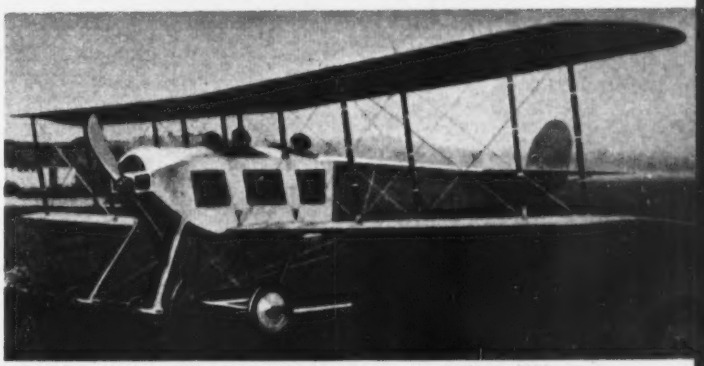
29 *The 1913 Deperdussin Gordon Bennett racer.*

30 *A "Flight" photograph of the original Avro 504, flown at Brooklands in 1913.*

1913 Something *like* a racer was the Deperdussin monoplane with 160 h.p. Gnôme engine (**29**), which won the 1913 Gordon Bennett Trophy at 124 m.p.h. and was developed from the first machine to exceed 100 m.p.h.

Truly the "Deps." were star performers; but we in Britain also had our stars—a galaxy, in fact, and a sign to the world that we could build fine aircraft as well as ships. On this page we introduce some of the best. First (**30**) is the original Avro 504. During the Kaiser war alone well over 8,000 machines of this class were turned out and 504s were serving as trainers well into the 1930s. The lesser-known Sopwith three-seater (**31**) carried a load of 450 lb at 70 m.p.h. on 80 h.p.

A far bigger weight-lifter—and the first four-engined aircraft—was Igor Sikorsky's *Russian Knight*, alias the *"Grand."* It weighed about 9,000 lb and had a span of 92ft. Mr. Sikorsky recalls that the front part "was occupied by a large balcony" and that next came the closed pilot's cabin, with two seats, double control and all flying instruments. The luxurious cabin had four seats, a sofa and a table, and there was a washroom and a wardrobe. The similar *Ilia Mourometz* (**36**) flew in 1914.



31 *"Tommy" Sopwith's efficient three-seater tractor biplane, 1913.*

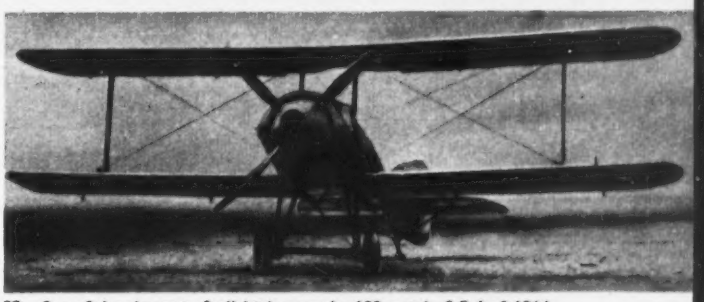
Part II The Kaiser War (1914-1918)

"It cannot last much longer than the spring."
And in the quiet, cloudless evening hour
The broad white wings descend with purring power.
The moonlight silvers the dark aerodrome:
And camp fires glow, and men sing songs of home.

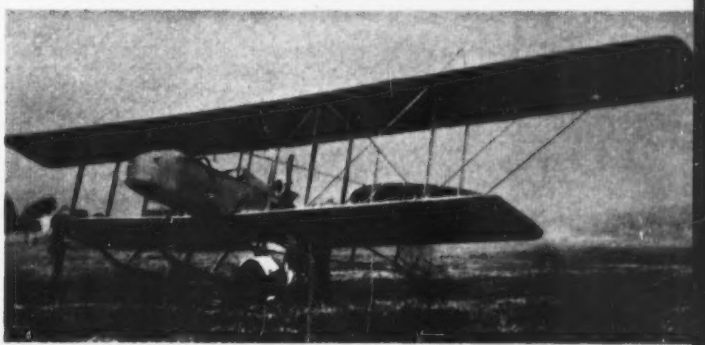
1914 The words are Maurice Baring's. But it was not all over by the spring, and for four years the aeroplane was being perverted in the ways of death. Nevertheless, the first machine we illustrate under the year 1914 (the Farnborough-built S.E.4 at **32**) was not intended for fighting but for the attainment of the highest possible speed compatible with safety. It was clocked at 130 m.p.h. Features included variable-camber flaps, fan-cooling, long-chord cowling and bubble canopy. One up to H. P. Folland and the Farnborough technicians. . . .

Next, at **33**, is the Vickers Gun Bus, or F.B.5, one of the first military aircraft designed to carry a machine gun; and the fifth of our British stars is the tiny Sopwith Tabloid (**34**) which, mounted on floats, won the 1914 Schneider race at 86.8 m.p.h.

1915 Scourge of 1915 (as were the Fw 190 and "Zero" in the late war) was the Fokker monoplane (**35**)—the first aircraft to mount a machine gun firing through the airscrew by means of interrupter gear (though the French had previously been firing ahead and deflecting bullets with steel plates).



32 *One of the cleanest of all biplanes—the 130 m.p.h. S.E.4 of 1914.*

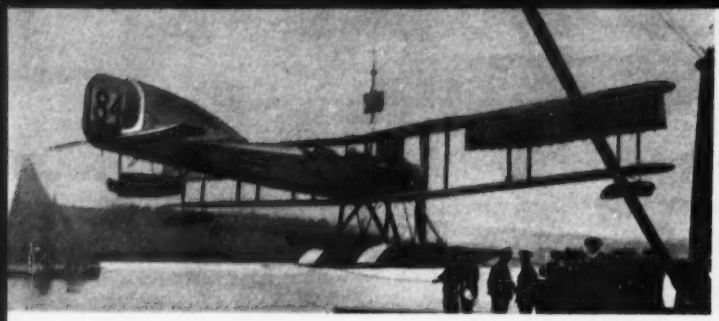


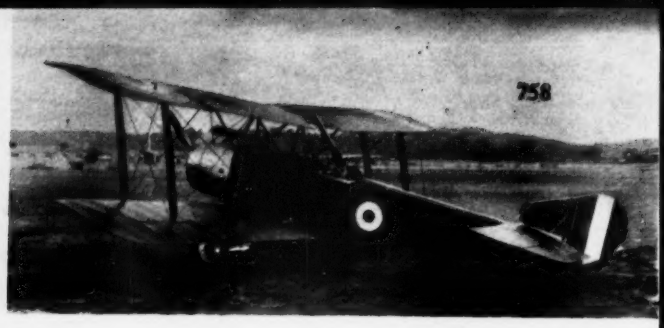
33 *Designed for air fighting—the Vickers Gun Bus of 1914.*

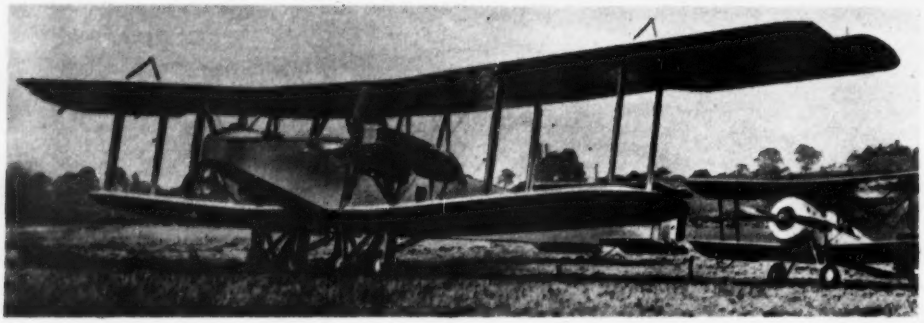
34 *A small parcel of goodness—the Sopwith Tabloid (1914).*

35 *Anthony Fokker's fixed-gun monoplane fighter of 1915.*

36 *Igor Sikorsky's "Ilia Mourometz" (1914), with two passengers taking a turn on deck. Note the ski undercarriage.*







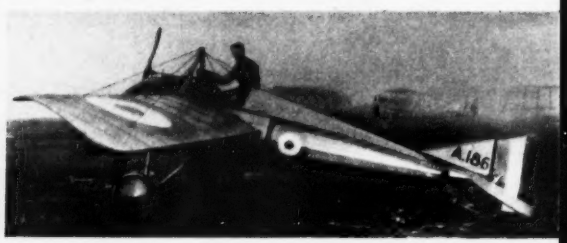
37 *(Top left) Short 184 torpedoplane, 1915.*

38 *(Above) Sopwith 1½-Strutter, 1915.*

39 *(Left) Handley Page 0/100 (1915) with Bristol Scout.*

40 *(Lower left) Junkers J 1, 1915.*

41 *(Below) Morane Bullet, 1915.*



THE FIRST FIFTY YEARS . . .

(1915 Cont.) New wars, new weapons—and in the Short 184 seaplane (popularly known as the "225" by reason of its 225 h.p. Sunbeam engine) we have the first practical torpedoplane, and one which succeeded in sinking a Turkish transport as early as August 1915. In those days each successive Short type-number was the service number of the prototype; so there is no question that the actual machine depicted at **37** was the very first of its series. Observe how the 14in torpedo was slung low between the flat-bottomed floats.

Dating from 1915, the Sopwith 1½-Strutter (**38**) was in active service by May 1916. This trim two-seater has several "firsts" to its credit: it was the first two-seat fighter built to the familiar front-fixed-gun/rear-swivelling-gun formula; it was, too, the first British aircraft to have interrupter gear for its fixed gun; and the first to be fitted with the famous Scarff ring mounting. Moreover, the "Strutter" had air brakes on the lower wings.

Though single-engined machines had been adapted for bombing in the early months of the war, it was not until a December night in 1915 that the prototype of Britain's first big, multi-engined bomber—the "bloody paralyser" demanded of Mr. Frederick Handley Page by the Admiralty—was smuggled darkly from Cricklewood to Hendon. It flew before the New Year. Known at that time as the 0/100, it did, in fact, pass into service under that designation, though it was more familiar in its developed version, the 0/400. Flown by the Independent Air Force, 0/400s became the nocturnal bane of Rhineland towns and U-boat lairs. The production type, with Rolls-Royce Eagle VIII engines, weighed 14,000 lb, had a top speed of 97½ m.p.h., and took 45 minutes to climb to its absolute ceiling of 10,000ft. It could carry sixteen 112 lb bombs. A machine of this type was the first to fly from the United Kingdom to a destination outside Europe—namely Egypt—and our picture (**39**), wherein an 0/100 is seen with a Bristol Scout, explains why Arabs beholding it parked with Bristol Fighters and D.H.9As, exclaimed, "At last they have sent us *the* aeroplane of which these things were foals."

By 1915 the skill and resourcefulness of the Germans as aeronautical engineers was clearly apparent, and to the Junkers concern we must now give credit for producing, in the autumn of 1915, the world's first all-metal aircraft (**40**). Known simply as the J 1, it was made from welded sheet steel, and of its wartime inception Professor Junkers—arch-advocate of the metal cantilever monoplane—has said: "No one would believe that it could fly. . . . A famous war pilot once asked a friend who

42 *(Top left) Caudron G.IV twin-engined bomber of 1915.*

43 *(Left) Royal Aircraft Factory S.E.5 prototype of 1916.*

44 *(Below) D.H.4 high-speed day bomber of 1916.*

45 *Nieuport 17 sesquiplane fighter of 1916.*

was flying the metal airplane: 'Are you so tired of life, then, that you are flying a machine without bracing wires?' The trial flights, however, gave splendid results."

Illustrative of French development at this period is the Morane Bullet (**41**), with the steel bullet-deflecting plates to which we have already referred, and a twin-engined Caudron G.IV (**42**), used for reconnaissance and bombing. A G.IV is still flying.

1916 In Britain during 1916 were flown the prototypes of some of the world's finest military aircraft, notable among which were the S.E.5 single-seat fighter (**43**) and the D.H.4 fast day bomber (**44**). Though the particular S.E.5 illustrated is the prototype, developed production-type machines of the series (mostly bearing the suffix "A") were essentially similar. A distinctive feature was the armament, comprising a single fixed Vickers gun set in the cowling, and a Lewis carried above the top wing on a Foster mounting, whereby it could be used in conjunction with the Vickers as a fixed forward-firing weapon, or pulled down on its track to fire upwards.

Though it is commonly believed that the first day bomber which could outstrip contemporary fighters was the Fairey Fox of 1925, the distinction is rightly accorded the D.H.4, the prototype of which flew as early as August 1916. Finest of the many versions was that with the 375 h.p. Rolls-Royce Eagle VIII. Without its bombs this could achieve 143 m.p.h. A Vickers gun fired ahead, a free Lewis covered the rear, and four 112 lb bombs could be slung under the wings. Experiments were made with D.H.4s mounting an upward-firing 1½-pounder gun.

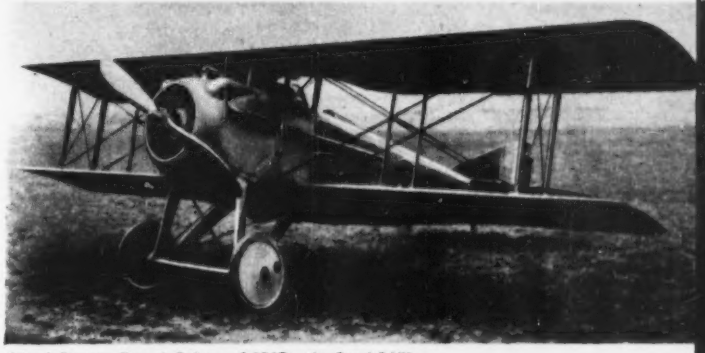
Though biplanes predominated in World War I, sizeable quantities of monoplanes were engaged in the first two years or so of the conflict. Very successful, too, were sesquiplanes, appropriately represented by the Nieuport 17 at **45**, and triplanes, exemplified by the Sopwith at **46**. A Fokker triplane established a reputation for itself late in 1917. Though relatively slow, these "three-deckers" were extremely manœuvrable. Once out of true, however, they were a little difficult to re-rig.

1917 Preferences in the matter of fighting qualities varied sharply between individuals and units, and there was a case of an R.N.A.S. squadron, equipped with French Spads of the type represented at **47**, arranging a "swop" with an R.F.C. squadron armed with "Tripehounds". There will always be contention, moreover, as to which was the finest of all Allied fighters, the S.E.5 or the Sopwith Camel (**48**). Of the two, the S.E. was the more tractable; the Camel, in fact, was something of a handful, being hypersensitive on the controls. But the fact remains: more enemy aircraft were shot down by Camels than by any other type of fighter of World War I. A formidable German fighter which was among those "seen off" by the Camel was the Albatros D.III (**52**). Its fuselage was plywood-covered and the engine was a 176 h.p. Mercedes. The usual German fighter armament of two Spandau machine guns was mounted.

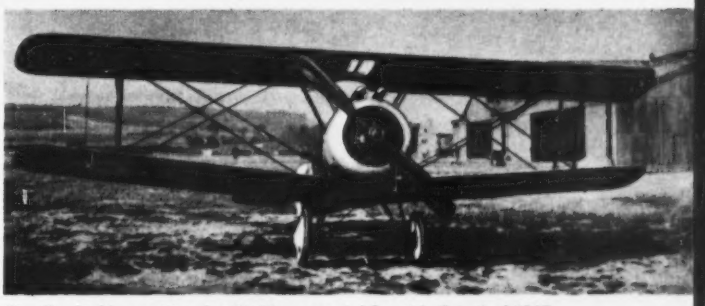
It has been noted how the Curtiss flying-boats were to influence design abroad, and especially is this apparent in the case of the Felixstowe ("F") boats produced in Britain under the supervision of W/C. J. C. Porte. The F.2A, as shown at **49**, is rightly famous for its dangerous and arduous North Sea patrols, which demonstrated in dramatic fashion the possibilities of the flying-boat in military service. Similarly, Germany's Gotha bombers (represented at **50**) showed that high-flying formations could attack England by night or day, though by mid-1918 our defences had caused them to desist.

The somewhat uninteresting-looking aeroplane at **51** is the Bréguet 14 and it has a place here for two reasons: it was largely of aluminium construction, and it was a "classic" general-purpose type in the French Air Force.

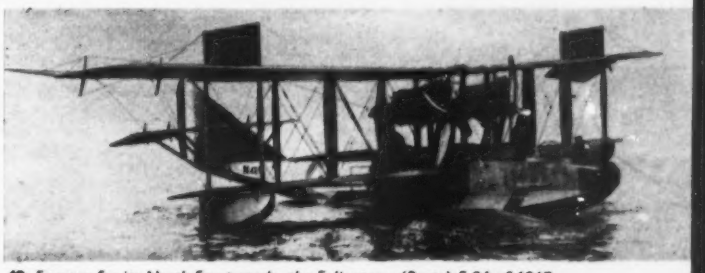
46 *The highly manœuvrable, fast-climbing Sopwith Triplane of 1916.*



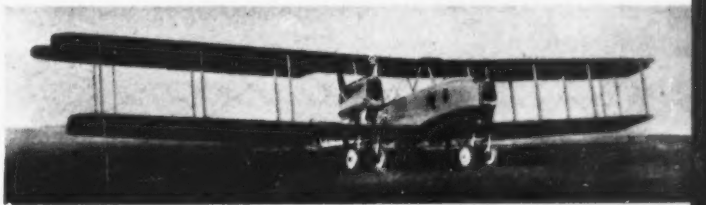
47 *A famous French fighter of 1917—the Spad S.VII.*



48 *The highly sensitive, but highly successful Sopwith Camel of 1917.*

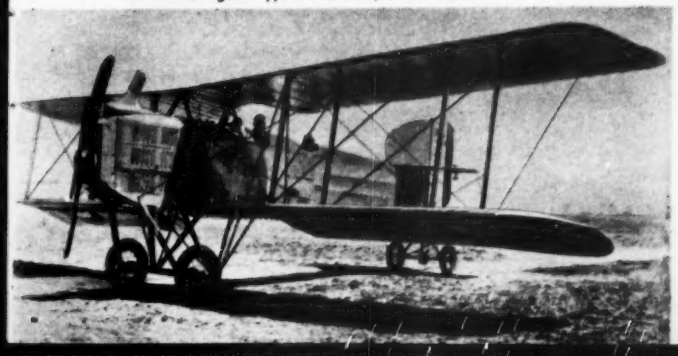


49 *Famous for its North Sea patrols, the Felixstowe (Porte) F.2A of 1917.*



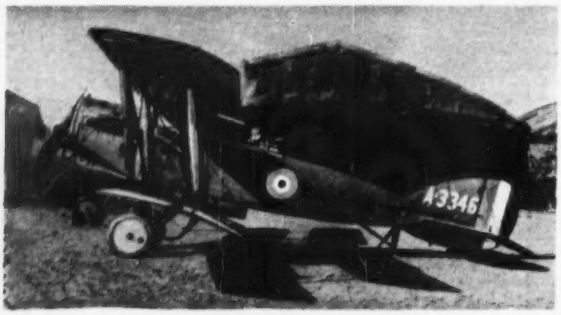
50 *One of the dreaded Gotha bomber family, the G.V of 1917.*

51 *The Bréguet Type 14 maid-of-all-work, 1917.*

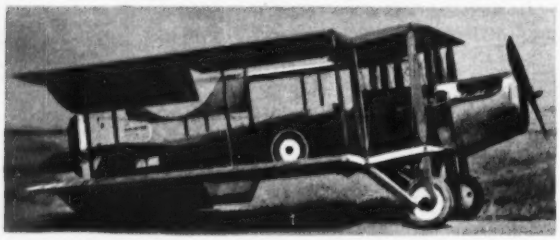


52 *A famous German vee-strutter fighter of 1917—the Albatros D.III.*

53 *An Italian triplane bomber of 1917—the Caproni Ca.41.*

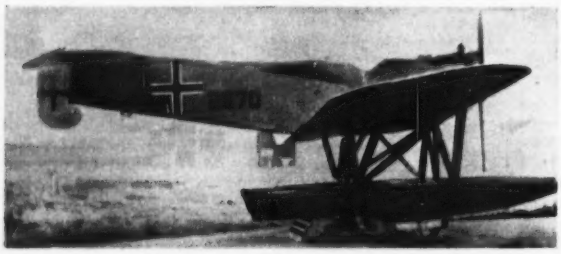


54 *The most famous two-seat fighter of all. Bristol Fighter of 1917.*



55 *First deck-landing torpedo-carrier was the Sopwith Cuckoo of 1917.*

56 *The Fokker D.VII of 1918, mentioned in the Armistice terms.*



57 *Dr. Heinkel designed the Brandenburg seaplane of 1918.*

58 *The fastest fighter of the war—the Martinsyde F.4, built in 1918*

THE FIRST FIFTY YEARS . . .

1917 (Cont.) On the preceding page we saw how the triplane met with some success as a fighter, and here we have it (**53**) as a bomber—the Caproni Ca.41. It should be explained that Senor Caproni was the Handley Page (or Sikorsky) of Italy in that he thought and built "big." Many of his bombers were biplanes but triplanes, of the general type shown, were used on operations.

Our tally of 1917 types ends with two British machines, both of technical interest, though one achieved fame and the other only distinction. The first is the Falcon-engined Bristol Fighter (**54**), the prototype of which was flown in 1916 and which entered service with the R.F.C. early in the following year. A well-crewed "Brisfit," with its front Vickers gun, single or twin rear Lewis, great strength, lively manœuvrability and useful performance could take on the enemy's best, and of one squadron it is said that enemy pilots did not consider it discreet to attack if more than three of its Bristols were together.

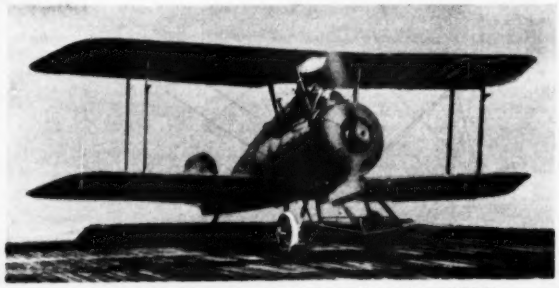
The machine for which we claim distinction, if nothing else, is the Sopwith Cuckoo (**55**)—the first deck-landing aircraft designed for torpedo dropping. The folding-wing feature shown was not, however, novel, having been used on Short seaplanes since 1912, and, indeed, on the unsuccessful French Vuia monoplane as long before as 1908.

1918 In his autobiography Anthony Fokker relates how he "came in for the doubtful honour of being the sole manufacturer to have his airplane specifically mentioned in the Armistice terms." He points out that Article IV, which detailed items which had to be turned over by Germany to the Allies, said: "*In erster Linie alle Apparate D.VII . . .*" (Especially all machines of the D-7 type). Certainly that fighter (**56**) was one of Germany's best. It was noted for its climbing power and ability to "hang on the prop"; but for all-round excellence it ran a poor second to the British Martinsyde F.4 (**58**) which, though in production at the Armistice, never reached the squadrons. It was the fastest machine to be quantity-produced by any of the warring nations and achieved 144.5 m.p.h. at 6,500ft. A brilliant contemporary was the Nieuport Nighthawk which, in common with many other British prototypes of the period, had the unsuccessful A.B.C. Dragonfly radial engine; and a slightly later design was the Siddeley Siskin, which, after "translation" into all-steel form, became a standard R.A.F. fighter.

The war at sea made special demands on designers; thus, when the Germans required a high-performance floatplane for North Sea work Dr. Heinkel obliged with the highly-respected Brandenburg monoplane (**57**). The oddly shaped tail allowed a clear field of fire and was imitated in the Fairey Pintail and Parnall Puffin.

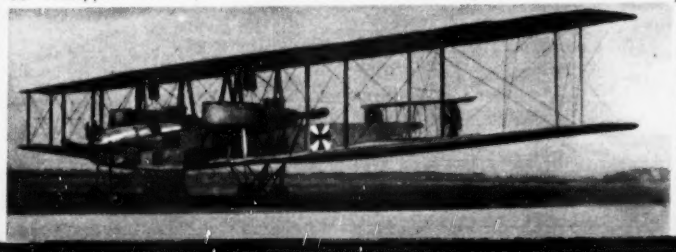
The products of the Parnall firm, incidentally, never failed to prove interesting, and the first of these—the Panther, seen at **59**—was especially notable. The fuselage of this deck-landing reconnaissance aircraft folded for stowage, was divided by watertight bulkheads, and contained flotation bags. Attached to the undercarriage was a hydrovane, to lessen the hazards of "ditching," and hooks, which engaged the fore-and-aft arrester cables of a carrier (see picture).

The massive bomber depicted at the foot of this page (**60**) is a German "Giant," of the class generally associated with the Zeppelin works but built by other manufacturers in various forms. The biggest of these, with its span of 160ft, was made by Siemens-Schuckert and had six engines of 300 h.p., whereas all others had from three to five engines. The Giants which raided England usually carried two pilots, an observer, two gunners, and about 2,200 lb of bombs. (The name Zeppelin, incidentally, was



59 *An early deck-landing aircraft, the Parnall Panther of 1919.*

60 *A Zeppelin Giant of 1918. Note nosewheel undercarriage.*



61 *Conqueror of the Atlantic: the Vickers Vimy bomber (Rolls-Royce Eagle engines) of 1918.*

associated shortly after the war with an extremely advanced four-engined transport monoplane—an astonishing effort.

Britain's counterpart of the Giant was the Handley Page V/1500, which was capable of carrying a 3,300 lb bomb. Three were being prepared to bomb Berlin when the Armistice was signed. A second "Berlin bomber" was the smaller, but extremely efficient, Vickers Vimy (**61**), which was to achieve renown in the days of peace by making the first non-stop crossing of the Atlantic on June 14th/15th, 1919. The pilot was Capt. Sir John Alcock, the navigator Sir Arthur Whitten Brown, and the distance of 1,890 miles between St. Johns, Newfoundland, and Clifden, Co. Galway, Ireland, was covered in 15 hr 57 min. The Vimy pattern was reproduced in the Vernon, Victoria and Virginia.

The compact Boulton Paul Bourges (**62**) headed a line of bombers which included the Bolton, Bugle and Sidestrand, and culminated in the Overstrand of 1935—the first aircraft to have an enclosed power-driven turret.

Last of the war-time machines is Italy's Ansaldo S.V.A. (**63**), fast, strong and having the Warren-girder bracing which was to characterize the Italian Fiat fighters of later years.

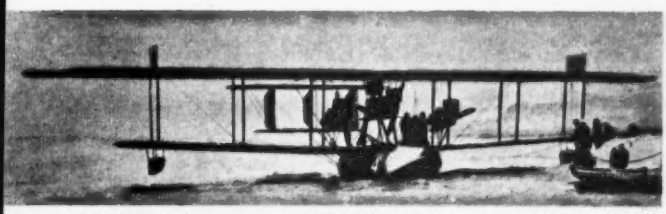
62 *The Boulton Paul Bourges of 1918 was fast and manœuvrable.*

63 *A successful Italian fighter—the Ansaldo S.V.A. of 1918.*

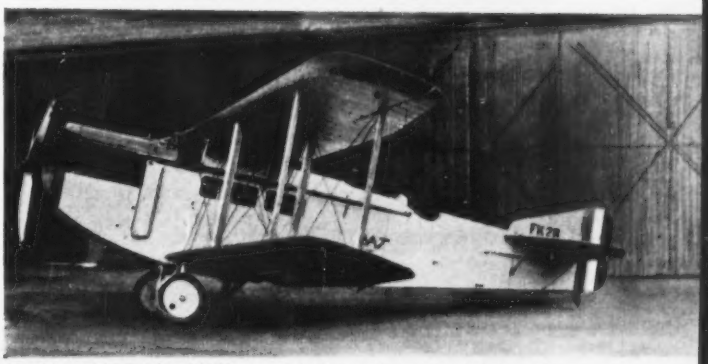
Part III The Restless Years (1919-1938)

1919 The majestic craft at (**64**) is the Curtiss N.C.4, one of three such machines which made a west-east Atlantic crossing *via* the Azores during 1919. The type was originally intended as a "flotilla leader" for the smaller "F" class boats, which were built by arrangement in America—whence their basic design had originally come!

Last we have four significant commercial biplanes: at **65** is Mr. Koolhoven's B.A.T. F.K.26, designed from the outset to carry passengers, freight or mails; at **66** and **67** are France's Farman Goliath and our own Handley Page W.8—both of them famous and successful—and finally (**68**) the Junkers F.13—the first low-wing, all-metal cabin monoplane. A milestone indeed.

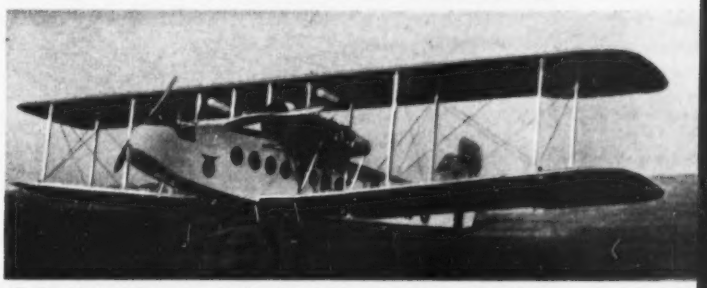


64 *Another conqueror of the Atlantic was the Curtiss N.C.4 of 1919.*



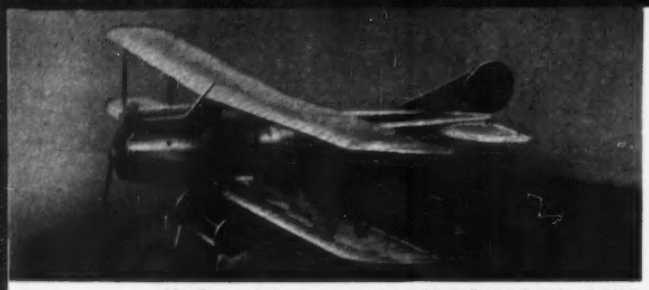
65 *The B.A.T. F.K.26 of 1919, one of the first truly commercial aircraft.*

66 *An early French civil effort was the Farman Goliath of 1919.*



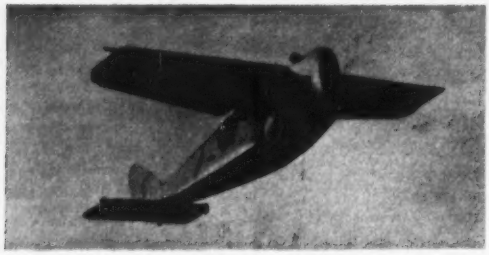
67 *Britain's counterpart of the Goliath was the H.P. W.8 (1919).*

68 *One of the most significant commercial aircraft of all time —the all-metal Junkers F.13, built in 1919.*

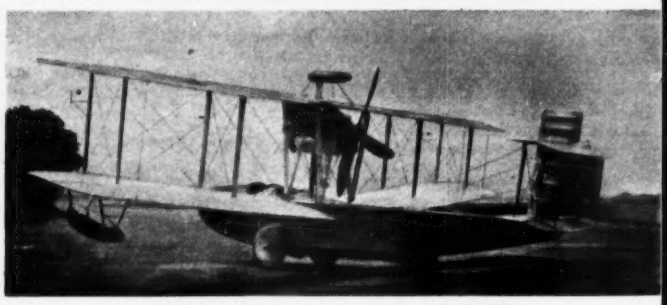


69 *Stressed-skin construction : Short Silver Streak of 1920.*

70 *On wheels or floats the Fairey IIID (1920) served the R.A.F. well.*



71 *Retractable wheels : the Dayton-Wright racer of 1920.*



72 *Winner of a £10,000 prize—the Vickers Viking III of 1920.*

THE FIRST FIFTY YEARS . . .

1920. A great deal of confusion still persists regarding the rightful place of the Short Silver Streak (**69**) in air history. This machine was, in fact, a very important one indeed, for it was the first in the world to have a metal *stressed-skin* (not simply metal-covered) structure; and by way of emphasis we quote from an article by Mr. Oswald Short which appeared in *Flight* during 1942: "The writer," it runs, "was the originator of stressed-skin all-metal construction, as carried into practice, in the year 1919. Until that time there was not a stressed-skin fuselage in the world. It was exhibited at Olympia in July 1920. I had been laughed at by my rivals but . . . *Flight* said: 'It goes without saying that the Short all-metal machine is not only the most interesting on this stand, but *the feature of the show*' (the italics are mine). The first to approach me at Olympia were officials attached to the American Embassy. They informed me that the American Government would buy the machine. I preferred, however, that it should remain in England, and one day later I was told that our own Air Ministry would purchase it, which it eventually did." Mr. Short goes on to relate how he applied the system to the construction of a hull. To Air Ministry order this was fitted to the antiquated superstructure of an F.5 flying-boat, and it proved its strength when, in rough weather off the French coast, it was stalled, and fell into the water from an estimated height of 30ft. Not a rivet leaked.

So although, as we later remark, the Singapore I of 1926 was the true founder of the great line of Short flying-boats, its construction was the outcome of experience with the Silver Streak and metal-hull F.5.

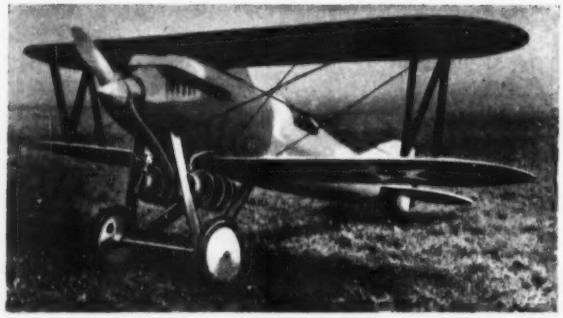
With Fig. **70**, showing the Fairey IIID, we introduce the work of a famous British company which had been founded in 1916 and had supplied the Royal Naval Air Service with many efficient floatplanes. The versatile IIID was itself a development of the 1916 Campania, and from it, in turn, stemmed the great family of IIIF, Gordon and Seal variants, examples of which continued in service until the late 1930s. Perhaps the greatest technical contribution made by the Fairey company during the first few years of its existence was the introduction of camber-changing trailing-edge flaps, initially fitted on an adapted Sopwith Baby.

A civil machine similar to the IIID was submitted for an Air Ministry competition for amphibians held at Martlesham Heath in 1920, but the winner of the £10,000 first prize proved to be the Vickers Viking III (**72**). Developments of the Viking (the first version of which had flown early in 1919), put in some stout work in Canada, where their construction under licence was among the earliest activities of the Dominion's domestic aircraft industry.

In such early amphibians the object of undercarriage retraction was to raise the wheels clear of the water, but in the Dayton-Wright racer of 1920 (**71**) we see, perhaps, the first example of an aircraft in which the wheels were tucked away in flight solely to reduce drag. A variable-incidence wing was another remarkable feature. This monoplane was entered for, but did not compete in, the Gordon Bennett Race of 1920, and it drew from *Flight* this comment: "Whether or not the arrangement would have resulted in a speed superior to that of the other machines, the originators of the design deserve credit for their courage in breaking away from conventionality and seeking improvement along original lines. There is little doubt that something like finality has been reached as regards the attainable speed with the aeroplane as we know it today, and if appreciably greater speeds are to be attained some other means will have to be adopted."

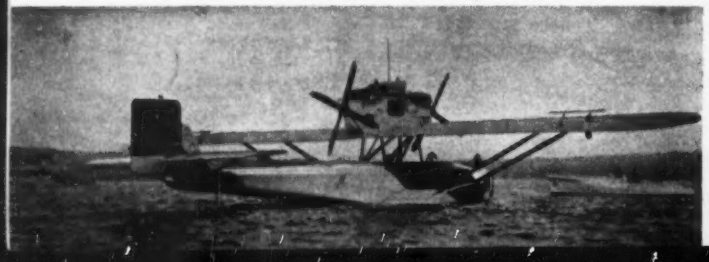
Although it seems fairly certain that the Dayton-Wright was the first high-speed landplane to use a fully retractable undercarriage, a semi-retractable gear was a feature of the James V. Martin K.III scout, built in America in 1919.

73 *A famous British racer—the Gloster Bamel (1921).*



74 *American counterpart of the Bamel—the Curtiss Navy Racer, 1921.*

75 *The Dornier Wal depicted is the original machine, built in 1922.*



76 *A pioneer British airliner—the D.H.34 of 1922.*

1921 An example of what could be achieved by a very clean biplane with fixed undercarriage was provided by the Gloster Bamel, or Mars I (**73**). This racer was based on the design of Mr. H. P. Folland's Nieuport Nighthawk fighter of 1918, and was powered with the stout-hearted Napier Lion "broad arrow" engine. It was victorious in the first post-war Aerial Derby in 1921, and again in 1922 and 1923. During 1922 it was used for an attempt on the world's speed record, and though it achieved 212 m.p.h., this figure did not exceed the standing record by the required margin. Succeeding Gloster fighters—notably the Grebe, Gamecock, Gorcock, Gauntlet and Gladiator—all owed something to the stubby little Bamel. In the same way, the design of America's Curtiss Navy Racer (**74**) was to be reflected in fighters, of various makes, for many years to come.

1922 This year is introduced with a picture of the prototype Dornier Wal all-metal, tandem-engined flying-boat (**75**) used very extensively over a long period in military, civil and research operations and for exploration—Amundsen's 1925 flight to the North Pole, in particular. The Wal did much to establish the efficiency of "sponsons" for lateral stability on the water, and these were to be retained on Dornier boats until the Do 24 (1938).

Those conversant with the problems attending the introduction of a modern airliner into service may be interested to know that the D.H.34 (**76**) first flew on March 26th, 1922, and that on March 31st it was delivered to Croydon, where pilots of the Daimler Airway learned to fly it before the first service flight—two days later!

The American Remington-Burnelli R.B.1 (**77**) is shown as the original example of the Burnelli lifting-fuselage principal which, though spasmodically revived over a long period of years, and notwithstanding attractive theoretical advantages (notably cabin spaciousness) never attained general popularity.

1923 It may have been noticed that all the high-speed machines to which we have had occasion to allude after 1919 were powered with liquid-cooled engines; indeed, the small frontal area of these units has always been a virtue much prized by designers of fast aircraft. In spite of its "sunflower" aspect, however, the air-cooled radial proved, when carefully installed, to have a surprisingly low drag, and in the Bristol Type 72 racer (**78**) a nine-cylinder Jupiter is seen in a ducted cowling.

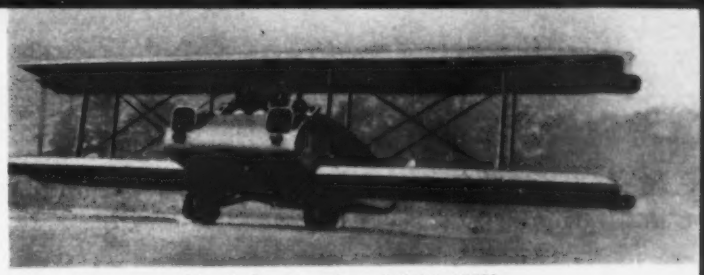
The picture of the C.4 Autogiro (**79**) represents the work of the Spaniard Juan de la Cierva in developing rotary-wing aircraft, wherein the rotor was driven by the passage of the machine through the air and not, as in the helicopter, by the engine. Cierva's earliest designs did not embody the "flapping hinge" principle, as did the C.4 depicted, but all subsequent models were to have this feature. The Autogiro was introduced into England—its adopted home—in 1925, and various types were built here, in America and France. Many continued in service until superseded by the new generation of helicopters.

1924 At **82** is shown one of the big Douglas World Cruiser biplanes which completed a round-the-world flight during the period April 7th-September 28th, 1924. The distance of 27,543 miles was covered in about 351 hours' flying time. Structurally the World Cruiser was identical to the DT-2 torpedo dropper and was operated both on wheels and floats.

Just before the close of the year 1924 France's beautiful Bernard racer (**80**) succeeded in raising the world's speed record to 278 m.p.h.—a figure which was not to be achieved by standard fighting aircraft for many years to come.

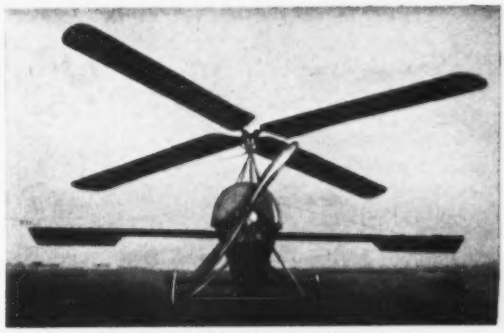
1925 **Fig. 81** shows a wooden-hulled Supermarine Southampton; later machines of this very famous and successful class had a metal hull, which was about 450 lb lighter and did not soak up 400 lb of water after one month, as did the wooden machine.

The original de Havilland Moth, which was the means of opening up a new era of private flying, appears at **83**. From this little tandem two-seater, with its 60 h.p. Cirrus engine, were evolved the Gipsy Moth and Tiger Moth series upon which thousands of pilots were to take their tickets—many of them (in the Tiger Moth) during the 1940s and '50s. The delightful Moth family eventually included the Puss and Leopard high-wing cabin tourers, and the Hornet Moth and Fox Moth biplanes.



77 *Bold but unsuccessful—the Remington-Burnelli R.B.1 of 1922.*

78 *Radial-engined racer—the Bristol Type 72 of 1923.*



79 *Juan de la Cierva's C.4 Autogiro, 1923.*

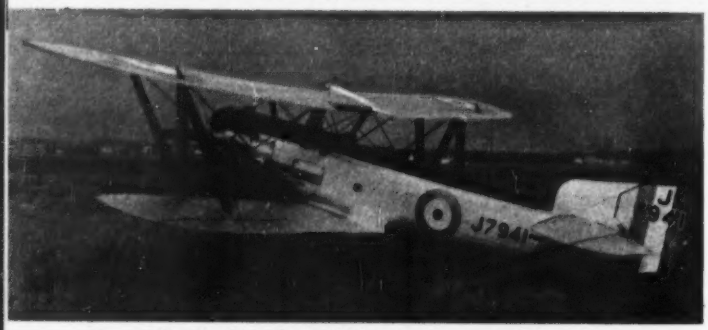
80 *The Bernard racer which achieved 278 m.p.h. in 1924.*

81 *A wooden-hulled Supermarine Southampton of 1925.*

82 *One of the stalwart Douglas World Cruisers of 1924.*

83 *The original de Havilland Moth (A.D.C. Cirrus engine) of 1925.*

84 *Forerunner of the famous Ford Trimotor—the Stout Pullman of 1925.*



85 *The Fairey Fox I of 1925 set a new standard of bomber performance.*

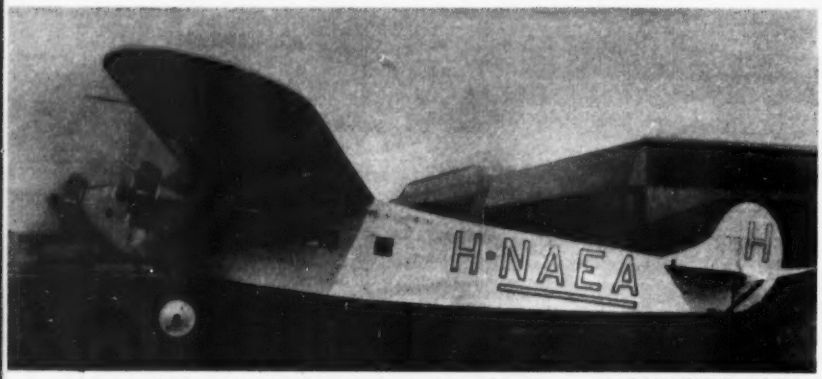
1926 The experiments of the Englishman Dunne with his early tailless machines will be recalled; and here recognised, with a picture of the Westland-built Pterodactyl Mk Ia (**87**), is the work of Professor G. T. R. Hill. This was to culminate in the Pterodactyl Mk5 experimental tailless two-seater fighter of 1932.

Short's swan-like Singapore (**88**), the founder of a flying-boat line which included the Calcutta, Rangoon, Kent, Sarafand, Empire boat, Sunderland and Shetland, was used by Sir Alan Cobham in 1927 for his 20,000-mile survey flight round Africa.

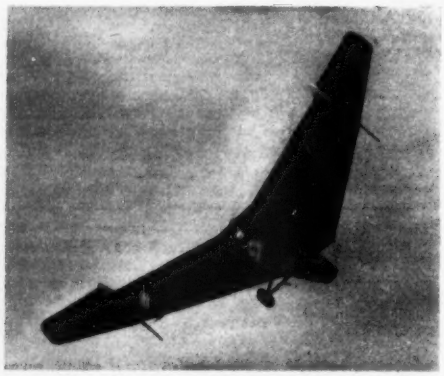
By this time Italy had plumped for monoplane flying-boats, exemplified by the twin-hull Savoia-Marchetti S.55 (**89**), famed for the impressive mass formation flight of twenty-four machines from Italy to America during July, 1933. In the lead was the audacious General Balbo, and in R.A.F. parlance any large formation is still a "Balbo."

Truly "full-rigged," the Armstrong Whitworth Argosy (**90**) is fondly remembered for its faithful service with Imperial Airways.

1927 The monoplane was now inexorably gaining ground—understandably so, in view of the brilliant success of machines like the Lockheed Vega (**91**), upon which beauteous and efficient design were the Lockheed fortunes founded. Less easy



86 *Equally successful as airliner and record-breaker was the Fokker F.VII/3m of 1926.*



87 *Professor G. T. R. Hill's Pterodactyl 1a, of 1926.*

THE FIRST FIFTY YEARS . . .

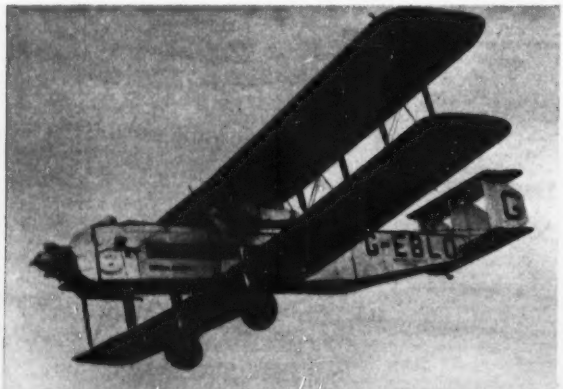
(1925 Cont.) In the Stout Pullman (**84**) is seen the basis of America's famous Ford Trimotor, which resembled in layout the still-more-famous Fokker F.VII/3m (**86**) though it differed (in the slang of the day) in being of "all-tin" construction. To the honour of the ubiquitous steel, wood and fabric three-engined Fokker there stands an enviable tally of pioneer achievements, crowned by the first Pacific crossing of Sir Charles Kingsford-Smith. It is worth noting, incidentally, that three internationally famous commercial aircraft—the Fokker F.VII/3m, Ford Trimotor and Junkers Ju 52/3m—were triple-engined, and that each was evolved from a single-engined design. The three-engine formula was to find favour in Italy for many years and culminated in such designs as the Savoia-Marchetti S.83 of 1938 (Fig. **154**).

It has already been remarked how the American Curtiss designs—marine aircraft and, later, racers—influenced thought abroad, and Curtiss technique is here in evidence again, in the elegant Fairey Fox I. With its speed of nearly 160 m.p.h. this aptly named day bomber was able to outstrip contemporary fighters, just as the D.H.4 had done before it. The "secrets" underlying the Fox's performance were extra-careful aerodynamic design, full exploitation of the low frontal area of the Curtiss D.12 (Fairey Felix) engine, and the "disappearing" Fairey gun mounting.

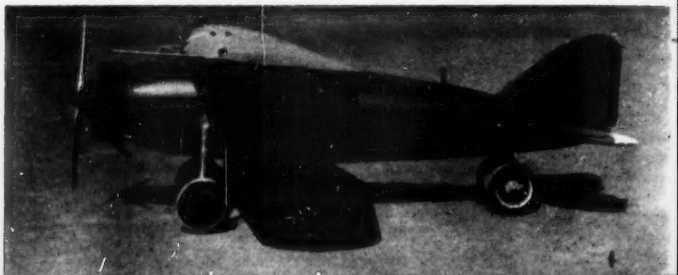
88 *The Short Singapore I of 1926 had two Rolls-Royce Condors.*

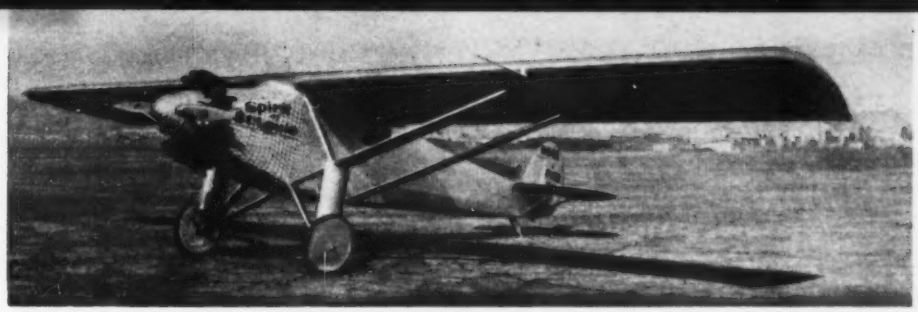
89 *Italy's Savoia-Marchetti S.55 (1926) had twin hulls.*

90 *A famous British airliner—the Armstrong Whitworth Argosy of 1926.*



91 *The original, Whirlwind-powered, prototype Lockheed Vega, 1927.*





92 *New York-Paris in 33 hr 30 min non-stop was Lindbergh's achievement in the Ryan "Spirit St. Louis" on May 20th/21st, 1927.*

on the eye but even more famous was the Ryan monoplane *Spirit of St. Louis* (**92**), in which Charles Lindbergh, on May 20th-21st, 1927, bridged the 3,600 miles between New York and Paris non-stop in 33 hr 30 min. As in the Vega, the engine was a Wright Whirlwind. Comparable in merit were contemporary Bellancas.

1928 Britain was now "getting in on the monoplane act." Basically of German Rohrbach design, the Beardmore Inflexible (alias Brittle or Inexplicable) (**93**) was considerably modified by Beardmores, but alas, too little of the 37,000 lb gross weight was available as load. An all-British design which certainly did carry a large load was the Fairey Long-Range Monoplane (**94**), a development of which established a world's distance record of 5,309 miles early in 1933.

1929 Even in the private-owner field the cantilever monoplane was finding acceptance, as witness the Desoutter monoplane (**95**); but in the R.A.F. the biplane lost ground very slowly. With the advent of the Hawker Hart (**96**) it was, in fact, to burst into a final phase of brilliant success.

In the Fairchild 71 (**97**) we see a sturdy bush transport which served long and faithfully in Canada, and in the Supermarine S.6 (**98**) a sporting aristocrat, powered by the superb Rolls-Royce "R" engine and victorious in the 1929 Schneider Race. The S.6B of 1931 finally secured the Schneider Trophy for Great Britain and was the first aircraft to fly at over 400 m.p.h.

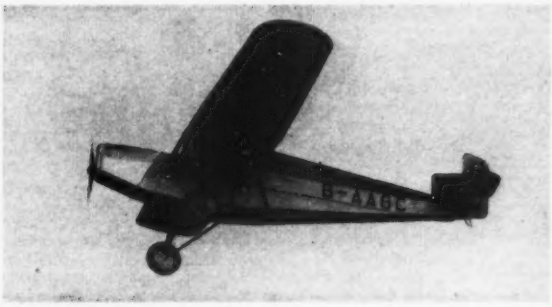
A weightier proposition was the huge Dornier Do X (**99**). In its original form, as shown, it had twelve Siemens-built Jupiter engines, but these were later replaced by Curtiss Conquerors. Two military Do Xs supplied to Italy had Fiats. Less dignified, but of great technical significance, was the Handley Page Gugnunc, seen gambolling in Fig. **100**. Its speed range

93 *The Beardmore Inflexible (1928) was basically of Rohrbach design.*

94 *Fairey Long-Range Monoplane (Napier Lion engine), built in 1929.*

was 33.5 to 112.5 m.p.h.—by virtue, it is hardly necessary to add, of Handley Page automatic slots and flaps.

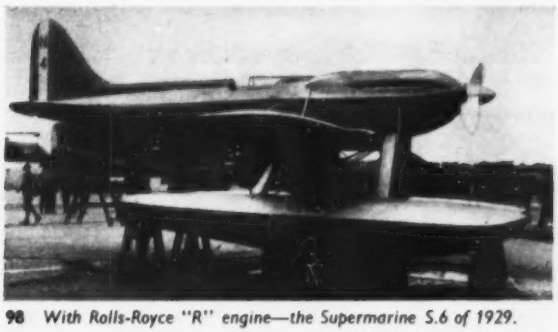
During 1928 it was ordered that H.P. slots should be fitted to most British Service machines, and eventually aircraft incorporating the device were built in no fewer than 43 countries.



95 *The trim Desoutter private-owner monoplane, 1929.*

96 *Banking at Brooklands is the Hawker Hart prototype of 1929.*

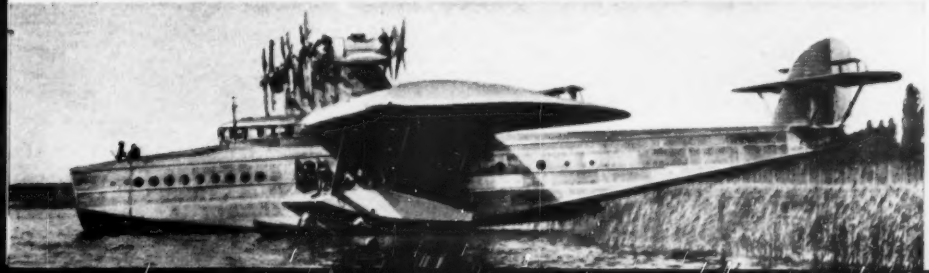
97 *"Rugged" and "husky" describe the Fairchild 71 (1929).*



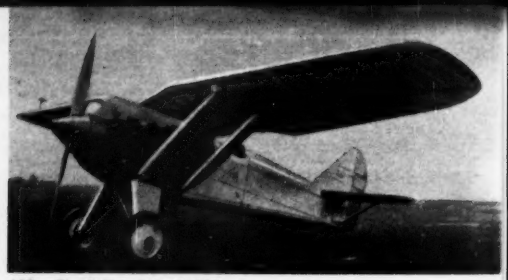
98 *With Rolls-Royce "R" engine—the Supermarine S.6 of 1929.*

99 *A magnificent experiment—the Dornier Do X flying-boat of 1929.*

100 *For the Guggenheim contest—the Handley Page Gugnunc, 1929.*

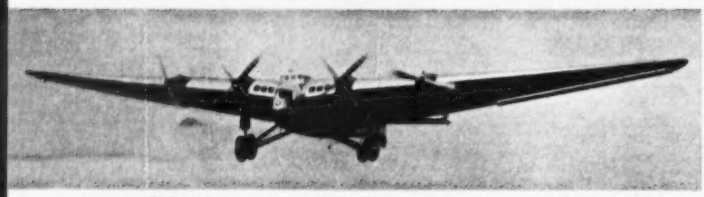


101 *Built-in comfort and built-in headwinds—the H.P.42, 1930.*



102 *The P.Z.L. P.1 of 1930 was a credit to Poland*

THE FIRST FIFTY YEARS . . .

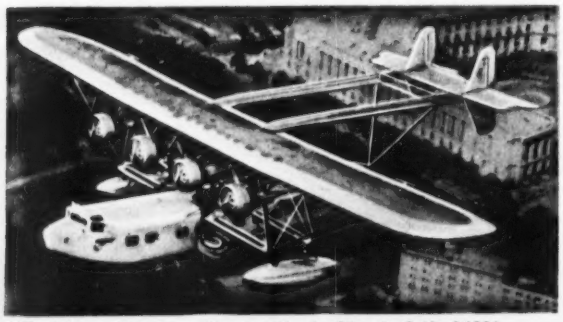


103 *An approach to the all-wing ideal—the Junkers G.38 of 1930.*

104 *The Caproni 90 P.B. was the biggest bomber of its day (1930).*

105 *Focke-Wulf Ente (1930), designed to be stall-and-spin-proof.*

106 *A really successful ultra-light aircraft was the 1930 Aeronca.*



107 *Like a clipper crowding on sail—the Sikorsky S.40 of 1931.*

1930 In the late 1920s and early 1930s a common formula was to be discerned in the design of three dissimilar Handley Page aircraft—the Gugnunc competition machine, the H.P.42 airliner and the Hare day bomber. This formula made use of biplane wings, wherein the lower were much inferior in span and chord to the upper; of rigid interplane bracing; and of slots on the upper wings (in the case of the Gugnunc, on the lower wings also). It is seen to good advantage in the picture of the H.P.42 at **101**—a portrait of one of the best loved airliners ever built and one which offered safety, comfort and spaciousness in unrivalled degree. Speed, however, was of such an order that with a headwind on the London-Paris run progress seemed almost negligible. It was, alas, the H.P.42 which kindled the phrase "built-in headwinds"; nevertheless it will always be remembered as a great-hearted giant, which did Britain much credit. A comparable German type was the Junkers G.38 (**103**)—a somewhat distant approach to Professor Junkers' ideal of the all-wing transport. Eventually it was fitted with Junkers diesel engines, as indeed were a number of other types of the same manufacture. A third (this time Italian) approach to the problem of large-aircraft design was the somewhat unusual one evident in the picture of the Caproni P.B. at **104**. Mightiest bomber of its day, this 25-ton monster set up six world records for load-carrying. Note the gun position perched on top of the upper wing and the tandem disposition of the six Isotta-Fraschini engines.

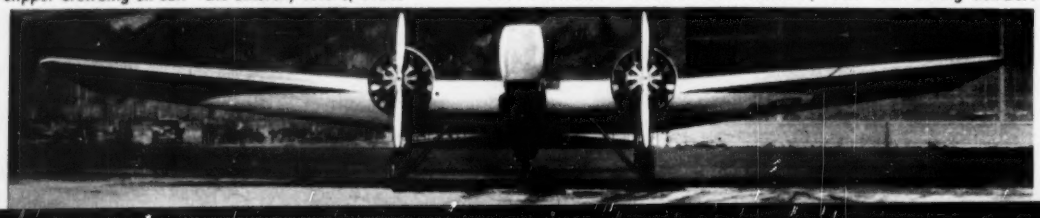
An even more strangely contrived machine, of German origin, was the tail-first, unstallable, unspinnable Focke-Wulf Ente (**105**). The P.Z.L. P.1 single-seat fighter (**102**) was a notable Polish achievement, and its essential features were repeated in subsequent models which were to see action in the late war.

The first ultra-light aircraft to meet with widespread success was the Aeronca (**106**) which, though of American origin, was also well known in Great Britain. Various models were marketed, typical of these being a single-seater with a 30 h.p. engine and a side-by-side-seater of 36 h.p.

1931 The reader may remark (and not entirely without justification) that the Sikorsky S.40 amphibian at **107** does not appear to represent a very great aerodynamic advance over the same designer's *Ilia Mourometz* of seventeen years earlier (Fig. **36**). It did, however, give good service and a contemporary specification claims a cruising speed of 115 m.p.h. and a top speed of 133 m.p.h. The tail booms were characteristic of the big Sikorsky amphibians of the period.

Strongly contrasting with this "birdcage" is the Boeing Bomber monoplane, the clean lines of which are admirably brought out in the head-on view at **108**. With its ring-cowled Pratt and Whitney Hornet engines, retractable undercarriage and bomb load of 2,400 lb, this was a milestone in military aircraft development, and the patriarch of the Boeing monoplane-bomber line, which has included the B-17 Fortress, B-29 Superfortress and B-47 Stratojet. A companion type was the single-engined Monomail, and a later civil development was the famous Model 247.

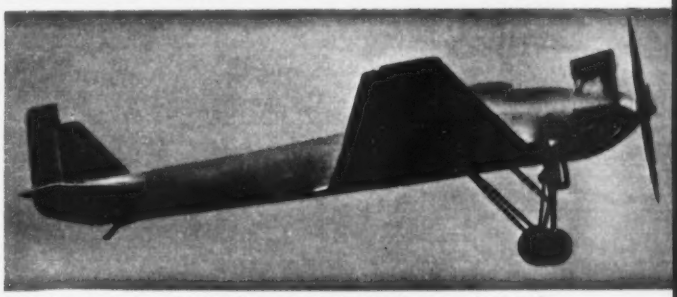
108 *A brilliant American achievement of 1931—the Boeing Bomber.*



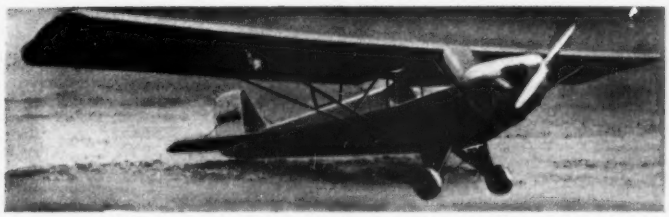
109 *The Wibault 281 (1931) exemplified French metal construction.*

110 *Fastest civil aircraft of its day was the Lockheed Orion (1931).*

111 *With British undercarriage—the Kawasaki Army Type 92 (1931).*



112 *The Junkers Ju 49 (1931) was a high-altitude research aircraft.*



113 *A layout which is still familiar today—the Taylor Cub of 1931.*

(1931 Cont.) The French constructor Michel Wibault was noted for skilfully designed metal airframes, and at one time he collaborated with our own Vickers organization, one of the products of the association being the Vickers-Wibault parasol monoplane fighter. Fig. **109** shows the Wibault 281 ten-passenger, all-metal monoplane, powered by three Gnôme-Rhône Titan engines and a forerunner of the Type 282, which gave dependable service on Air France routes. Unlike former Wibaults, it was smooth-skinned and had a notably high performance for its day, the maximum speed being 148 m.p.h.

Clean as it was, however, the Wibault did not have a retractable undercarriage. It was the American Lockheed company with their Orion (**110**), which demonstrated the commercial advantages offered by this feature. The Orion was one of those aircraft (and a number of them have been of Lockheed design) which every now and then make people in the air transport business sit up sharply and take notice. The actual example illustrated maintained a high-speed passenger and mail service between Los Angeles and San Francisco at an average of about 182 m.p.h. The type was also taken up in Europe, by Swissair, and one reads in *Flight* how, when the Swissair Orion landed at Le Bourget, a number of French constructors were waiting to examine it, including Louis Blériot, Henry Farman, Michel Wibault and René Caudron. In Germany, Professor Heinkel was distinctly interested, and his graceful He 70, shown overleaf, was taking shape in his mind.

It was generally contended by detractors of the retractable landing gear that the penalties of weight and complication were often prohibitive, and it is true that speeds were generally such as to cause designers to think carefully, and think again, before embracing the innovation. A case where useful weight was undoubtedly saved was that of the Ju 49 (**112**), a high-altitude research aircraft developed in conjunction with German experimental institutions. This was not the first pressurized aircraft, for as long ago as 1920 the U.S. Army Air Corps at McCook Field had installed an oval steel tank in the fuselage of a D.H.4 and had fitted a wind-driven pressurizing blower.

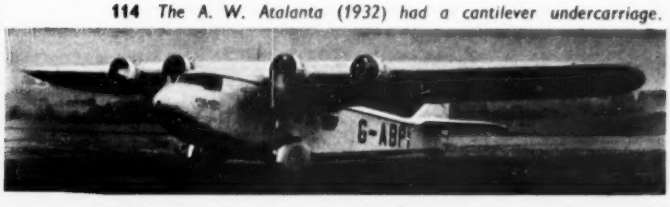
At this time even the fixed-undercarriage diehards were giving extra-special consideration to means of saving drag, and in the Japanese Kawasaki Army Type 92 fighter (**111**) we see the first application of the Dowty internally sprung wheel, later to be applied to the Gloster Gladiator and Westland Lysander. The engine of the Kawasaki fighter was of German B.M.W. type, giving a speed of slightly more than 200 m.p.h., which was fair going for a fighter of the day.

In the little Taylor Cub tandem-two-seater at **113** we have the true prototype of many thousands of machines built to the same basic formula and best known in this country under the Auster trademark. The example shown had an engine of only 35 h.p., which gave it a speed of 80 m.p.h.; the landing speed was little more than 25 m.p.h. Note, incidentally, that the undercarriage wheels were of the Goodyear Airwheel type, which was in vogue for some years on larger aircraft also.

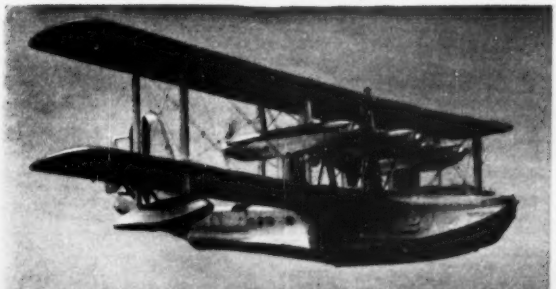
1932 The search for reduced undercarriage drag led the Armstrong Whitworth company, in their Atalanta airliner (**114**), to adopt a scheme which was unusual, if not unique. The compression legs, radius rods and the greater part of the axles were contained within the fuselage, the wheels being carried on cantilever structures projecting through the sides and fitted with carefully shaped "spats." A fleet of Atalantas gave good service with Imperial Airways, and the type had, for its day, a good performance, being capable of cruising at up to 130 m.p.h.

Second only in size to the Do X came Britain's Short Sarafand (**115**) with its six Rolls-Royce Buzzard engines disposed in tandem pairs. Notwithstanding the massive biplane superstructure, planing bottom and other excrescences, this great machine was only some 6 m.p.h. slower than the clean Atalanta monoplane.

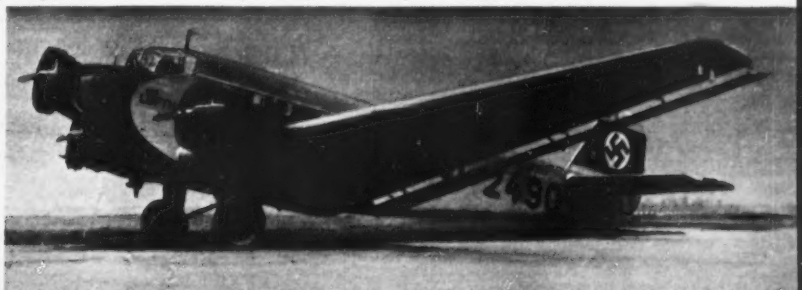
We save a special corner for a very great aeroplane indeed—the Junkers Ju 52/3m (**116**)—which, having served as an airliner, freighter and bomber, was adapted for paratroop dropping and other nefarious purposes during the late war and is still giving exemplary service. A distinctive feature of this and of other contemporary Junkers designs was the use of Junkers "auxiliary wing" flaps.



114 *The A. W. Atalanta (1932) had a cantilever undercarriage.*

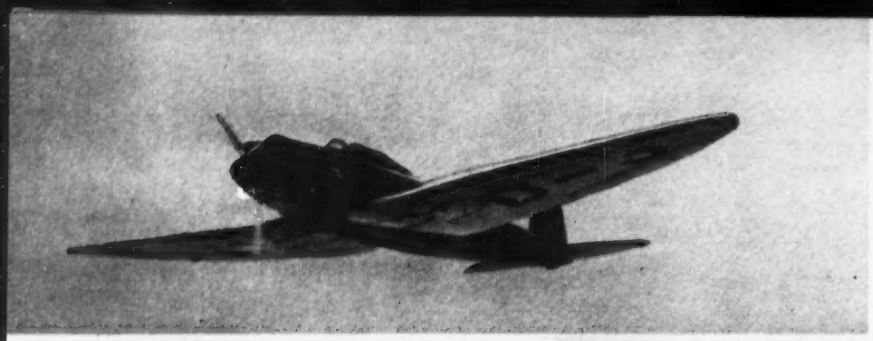


115 *Six Rolls-Royce Buzzard engines powered the Short Sarafand of 1932.*

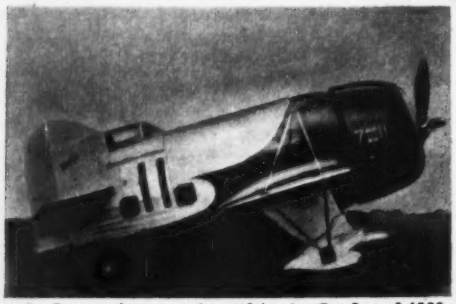


116 *Still in service today—the Ju 52/3m, introduced in 1932.*

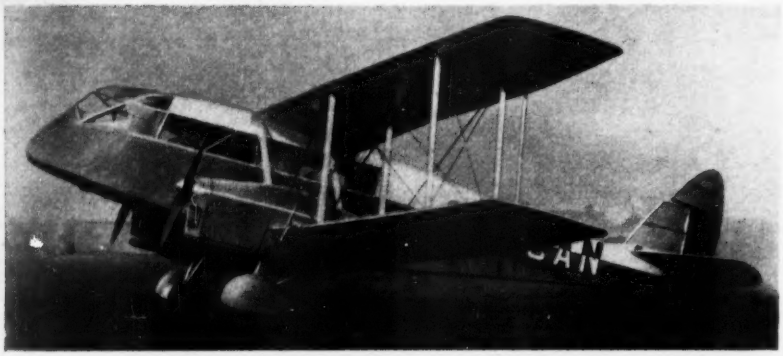
THE FIRST FIFTY YEARS . . .



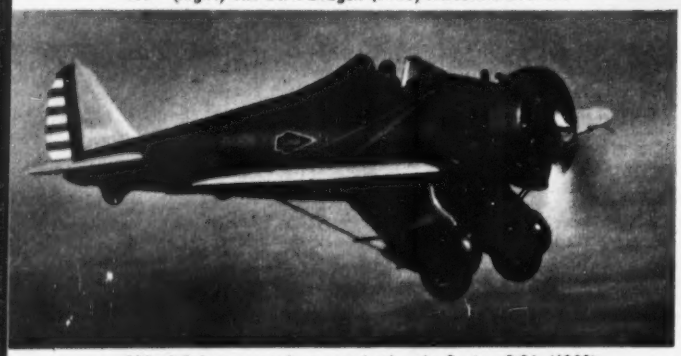
117 *Fast and beautiful—the He 70 of 1932.*



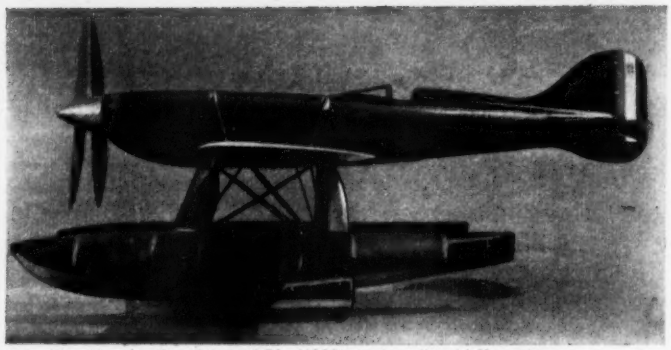
118 *Fast and not so beautiful—the Gee-Bee of 1932.*



119 *(Right) The D.H. Dragon (1932) miniature airliner.*



120 *A fighter-monoplane comeback—the Boeing P.26 (1932).*

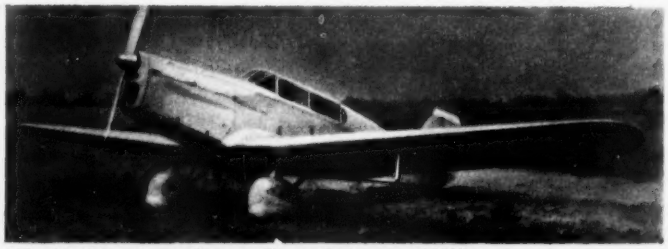


121 *The Macchi Castoldi M.C.72 (1932) had a "double" engine.*

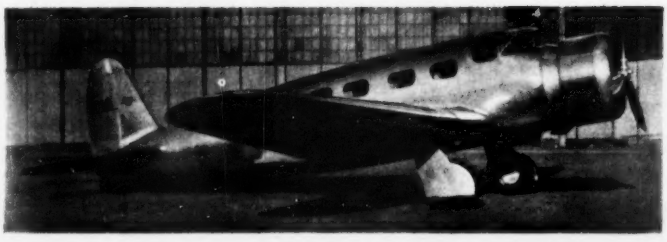
(1932 Cont.) By 1932 the monoplane was really beginning to come into its own; and of all the monoplanes of the period the most beautiful, and aerodynamically efficient, was the Heinkel He 70 (**117**). It is a point worth noting that one of these machines was purchased by Rolls-Royce, Ltd., for the testing of their Kestrel engines at high speeds, and that Kestrels were, in turn, supplied to Germany for installation in some of their new prototypes. Whereas the He 70 showed what could be done with a liquid-cooled engine, the Gee-Bee Super-Sportster (**118**) was literally built round a nine-cylinder, single-row Pratt and Whitney Wasp radial, which propelled it at the landplane record speed of 294.2 m.p.h. Like this racer, the Boeing P-26 fighter (**120**) was a wire-braced, low-wing radial-engined design, and it, too, had a fixed undercarriage. It marked the beginning of a gradual swing over to monoplanes by the U.S. Flying Services. Meanwhile, in Italy, the magnificent Macchi Castoldi M.C.72 racer (**121**), originally intended for the 1931 Schneider Contests, was being prepared for an attack on the world's speed record, which it succeeded in breaking during 1933 at 423.7 m.p.h.

In face of the monoplane onslaught the de Havilland company boldly put on the market the little twin-engined Dragon commercial biplane (**119**), a cheap, economical and easily maintained 6/8-seater, examples of which are still in service. But Britain was by no means blind to the advantages of the monoplane, as is proved by the racing and other successes achieved by the Percival Gull (**122**) and its successors, the Vega Gull and Proctor.

1933 On the preceding page we had a special corner for a very great commercial aircraft, and here (**124**) we have a similar corner for an even greater one. It is the DC-1—forerunner of the DC-2 and DC-3 (Dakota), familiar to most airlines and fighting Services, including those of Russia. It was a DC-2 of K.L.M. which secured second place in the England-Australia Race for the MacRobertson Trophy in 1933 at an average speed of 156 m.p.h., and the fact that this machine was standard, and that it carried passengers and mails, made a deep impression on operators the world over. Of the DC-3 type alone nearly 11,000 examples were built. In the single-engine class, and in the Orion tradition, came the Vultee V-1 (**123**).

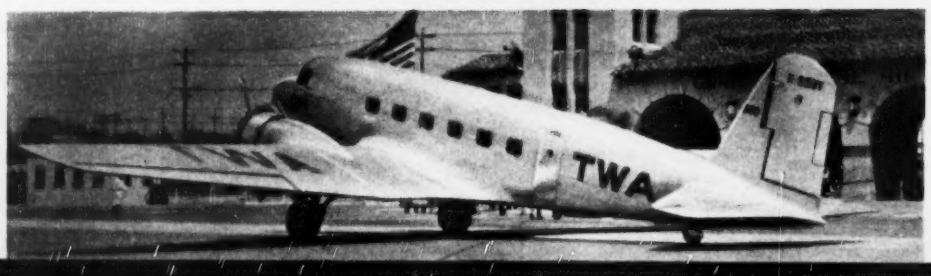


122 *Mr. Edgar Percival's very efficient Gull tourer of 1932.*



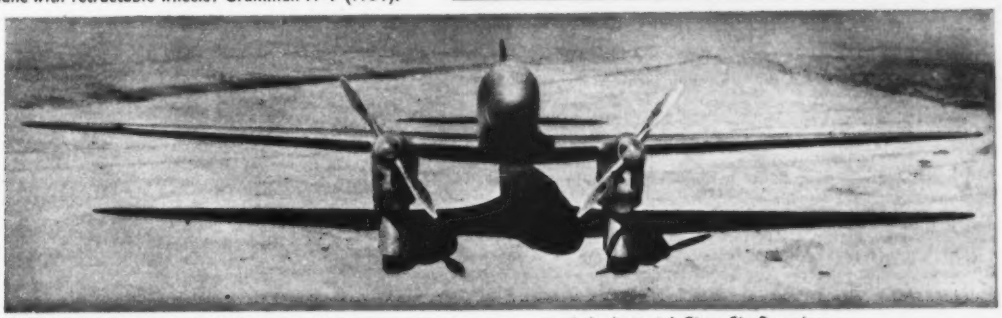
123 *(Upper right) Vultee V-1 (1933).*

124 *Backed by the stars and stripes stands the historic Douglas DC-1 (1933), forerunner of the far-famed DC-2, DC-3 and Dakota.*



125 *A notable British lightplane of 1933—the Miles Hawk (Cirrus III).*

126 *(Right) Biplane with retractable wheels: Grumman FF-1 (1934).*



127 *Seen frontally the D.H.88 Comet (1934) was almost non-existent. It had special Gipsy Six R engines.*

In Great Britain during 1933 Fred Miles built his trim, tandem-seat Hawk and managed to put it on the market for £395. It was a winner from the start and the first example (**125**) headed a prolific line of Hawk variants (e.g., the Magister trainer of the R.A.F.), and one which included fighter-trainers (Kestrel and Master); prototype fighters; unorthodox experimental machines such as the tail-first Libellula; tourers—notably the twin-engined Gemini light four-seater, one of which serves this journal so well today; and light freighters, best-known of which was the dumpy, thrifty little Aerovan.

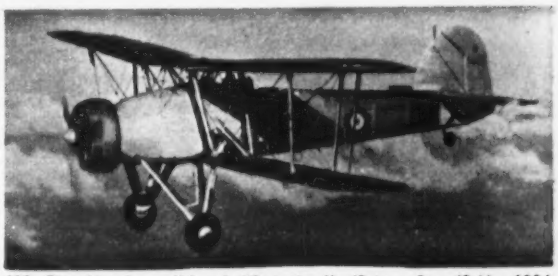
For Service use—particularly for carrier operation where dimensions and wing loading were critical—biplanes still found a ready acceptance. Aerodynamic refinement continued and the U.S. Navy's Grumman FF-1 (**126**) is an early example of a biplane fighter with a retractable undercarriage.

1934 Considered from any aspect the de Havilland Comet long-distance racer (**127**), tested in the late summer of 1934, was a brilliant achievement. Its purity of line was unrivalled by any other "twin," and its wooden structure, in which diagonal laminations were widely used, was fittingly advanced. Two special Gipsy Six engines, driving Ratier two-position airscrews, gave a top speed of some 235 m.p.h., and such was their economy that an ultimate range of 2,900 miles could be attained. This remarkable performance was, indeed, mandatory, for the Comet was designed solely with a view to winning the MacRobertson England—Australia race. Which, of course, a Comet won.

Although, as we have noted, America was showing a revived interest in monoplane fighters (as, indeed, were European countries), Great Britain clung tenaciously to the biplane; but in the Gloster F.7/30 (**128**), later famous as the Gladiator, we see the culmination of development. The Gladiator will be remembered as a remarkable compromise between the claims of speed, climb, fire power and manœuvrability, for it was capable of over 250 m.p.h., climbed to 20,000ft in 9 min, was armed with four guns, and displayed in high degree the characteristic handiness of preceding Gloster fighters. A development saw Naval service as the Sea Gladiator, and though Malta's glorious *Faith, Hope* and *Charity* were of this type, it was not destined for the fame and longevity of the Fairey T.S.R. (Swordfish) (**129**). Guardian angel of convoys, butt of the wags, victor of Taranto —that was the "Stringbag."

Sharply contrasting is the Caudron C.366 (**130**), a member of a brilliant French family which, by virtue of their small size and cleanness, achieved remarkable performances on low power. The Caudron 450, for example, although of only 325 h.p., established a 100-km record at 265.8 m.p.h., whereas the previous record had been achieved with all of 800 h.p. Contemporary French military thought led to less felicitous forms, of which the Bréguet 460 (**131**) was by no means the most rugged. With their turrets, battlements and balconies, these *multiplaces de combat* were of architectural rather than of aerodynamic merit. But they had their day, as had the "foolproof" *Pou-du-Ciel* of M. Henri Mignet (**132**).

128 *Prototype of the Gladiator—the Gloster F.7/30 of 1934.*

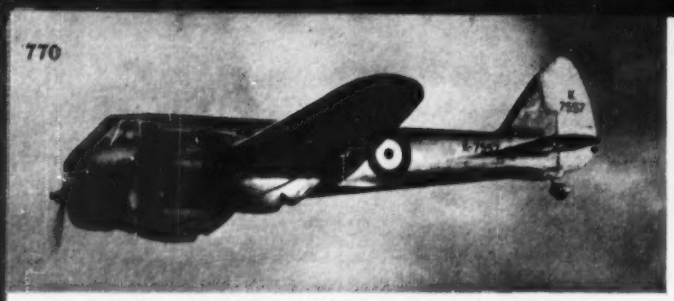


129 *The Navy's well-loved "Stringbag" (Fairey Swordfish), 1934.*

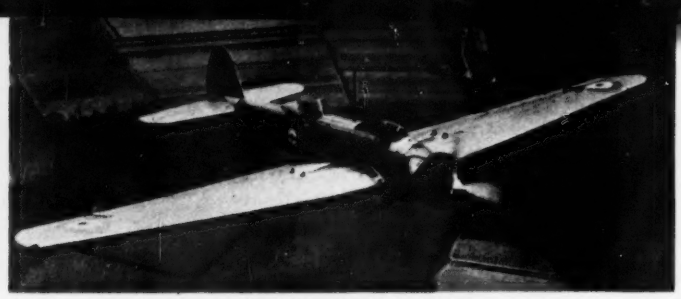
130 *A typical Caudron racer of 1934 was the C.366 Atalante.*

131 *French "multiplaces de combat" of 1934—the Bréguet 460.*

132 *Sky-louse from France: a "Pou-du-Ciel" of 1934.*



133 *"Britain First"—the 282 m.p.h. Bristol 142 of 1935.*



134 *Long span, long range—the Vickers Wellesley of 1935.*

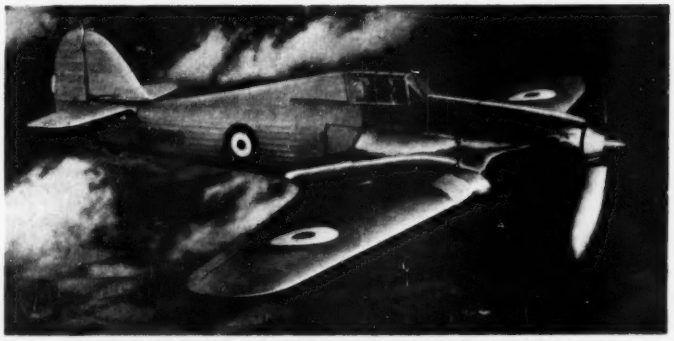
THE FIRST FIFTY YEARS . . .

1935 We now begin to find ourselves in company with machines which were to win their spurs in the war still four years off. The Bristol Type 142 *Britain First* (**133**), for instance, was the prototype of the Blenheim, which, when it entered service in 1937, was the pre-eminent light bomber and which served in the early phases of the struggle as a long-range fighter also. Built to the order of Lord Rothermere, *Britain First* was justly named for its speed of 282 m.p.h. was unequalled in its class.

In the design of the general-purpose Vickers Wellesley (**134**) range rather than speed was accentuated, and the fame of the type is principally founded upon the achievement of two Wellesleys of the R.A.F. Long Range Development Unit, which, in November 1938, set up a world record of 7,157.7 miles from Egypt to Darwin. The Wellesley was the first heavier-than-air machine to incorporate B. N. Wallis's system of geodetic construction.

At **135** and **136** we have Willy Messerschmitt's Me 109 and the Hawker Hurricane designed by Sydney (now Sir Sydney) Camm. The Me 109 we show is an early model, with Jumo 210 engine (later versions had the D.B. 601 or D.B. 605), and the Hurricane is the original machine with Merlin C engine and fixed-pitch wooden airscrew. The Messerschmitt eventually proved the faster, but the Hurricane had the advantage in manœuvrability and fire power, as Me pilots were to learn in many a grim duel.

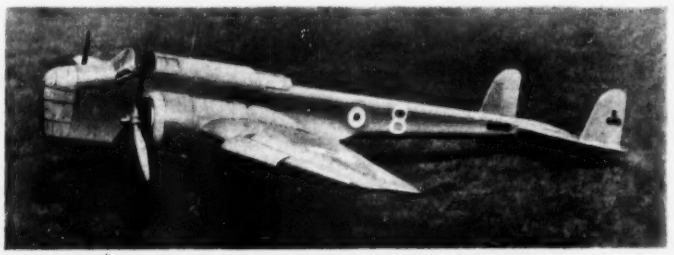
135 *This early-model Messerschmitt Me 109 was flying during 1935.*



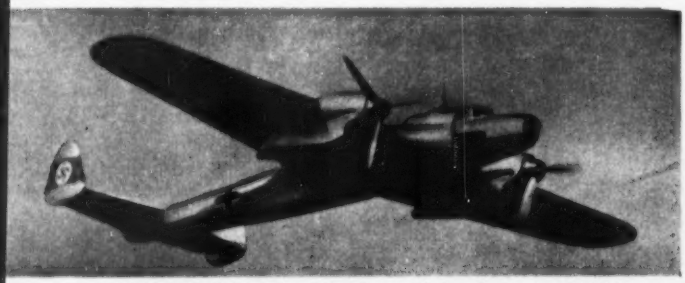
136 *The first Hawker Hurricane (with braced tailplane!) in 1935.*

1936 The redoubtable Hurricane was to be followed during 1936 by the prototypes of three other famous British warriors: the Handley Page Hampden and Vickers Wellington bombers (**137** and **139**), and that most renowned of all fighters the Supermarine Spitfire, masterpiece of R. J. Mitchell. Of the bombers, the Wellington was to have the longer career, and the type was serving until recently as a trainer. Even today the Spitfire is active on second-line duty. The first example, which we illustrate at **140**, had a top speed of 346 m.p.h. at 17,500ft, and in the first production version this had been raised to 362 m.p.h. at 18,500ft. The final development was the Mk 24, which was good for 450 m.p.h. at 19,600ft. The "Spit" appeared in dozens of variants, including fighter/bomber, fighter/reconnaissance and P.R. models. The deck-landing adaptation was the Seafire.

The German bomber seen flying on one "fan" (**138**) is a prototype Dornier Do 17, with Daimler-Benz engines. Dubbed the *Flying Pencil*, the Do 17 was the counterpart of the Blenheim, though, unlike the Blenheim and its own compatriot the He 111 it was not developed for civil use originally. From the start it was very much a bomber and it provides an excellent example of a machine in which a light, axially restricted armament was tolerated in deference to speed. The Hampden was similarly armed, but the Wellington mounted powered turrets.

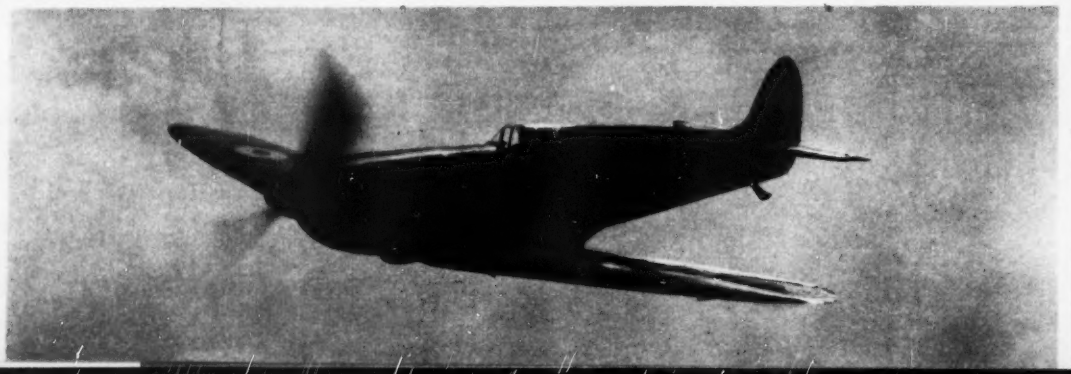


137 *Prototype of the Hampden was this Handley Page H.P.52 of 1936.*



138 *The "Flying Pencil"—Germany's Do 17 bomber of 1936.*

139 *Photographed in 1936, the Wellington prototype had no gun turrets.*

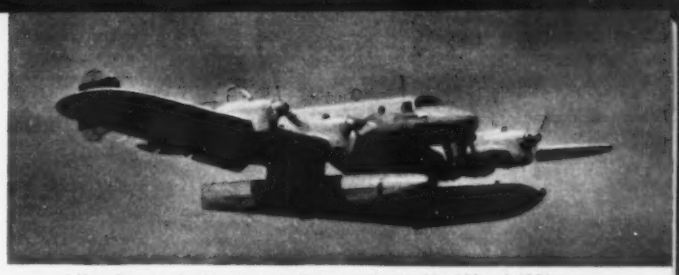


140 *An early test flight of the very first Supermarine Spitfire eight-gun fighter, during 1936.*

It happens by coincidence that the first four aircraft illustrated on this page are marine types, and of contrasting design. Number **141** is the Hamburger (later Blohm and Voss) Ha 139, of which three examples were built, and which, by late June 1939, had completed 40 North Atlantic and 60 South Atlantic flights. The engines were four Junkers Jumo 205 diesels, and fuel was stored in the tubular wing spar.

The large twin-float seaplane has always been something of a rarity, though less so in Italy than elsewhere, and a typical Italian specimen was the Cant Z.506B shown at **143**. This was a torpedo/bomber and reconnaissance aircraft, with a top speed of well over 200 m.p.h.

Both the Hamburger and the Cant were efficient designs, but neither rivalled in any degree the phenomenal success of the Short Empire flying-boat (**142**), which accommodated 17 passengers in real luxury, with their luggage and two tons of freight and Empire Air Mail. These majestic machines cruised at all of 160 m.p.h., and, although the normal range was 800 miles or so, it was extended in *Caledonia* and *Cambria* to over 3,700 miles, enabling pioneer commercial flights to be made over the North Atlantic. After the original 28 machines had been delivered, seven more, powered with Bristol Perseus instead of Pegasus engines, were put in hand. With two of these—*Cabot* and *Caribou*—the first commercial flight refuelling (from Handley Page Harrow tankers) was undertaken. There followed the three 33-ton "G"-class boats, with Hercules engines.



141 *Germany's diesel-engined, transatlantic Ha 139, of 1936.*

Upon the basic "Empire" design was founded the military Sunderland, which had a hull of broader beam, power-driven gun-turrets and very complete Service equipment. With a heroic war record behind it, the Sunderland continues its vigilance today as the standard R.A.F. patrol and reconnaissance flying-boat; indeed, it seems destined to grace the skies of the Commonwealth for several years to come.

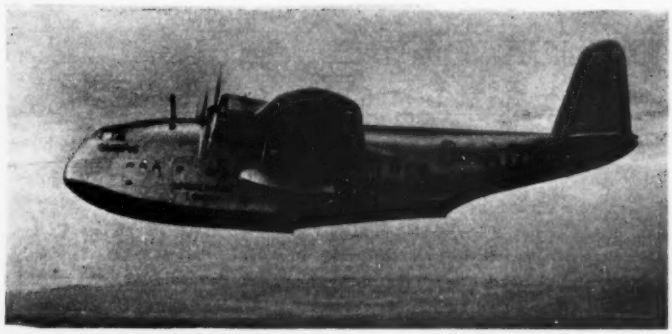
An American military flying-boat which matched the Sunderland's record was the Consolidated Catalina, the XPBY-1 prototype of which is shown at **144**. An amphibian version remains in service today with civil operators. It was the XPBY-1, incidentally, which set the fashion for retracting the lateral stabilizing floats to blend with the wing tips.

On its introduction, the Westland Lysander army co-operation monoplane (**145**) was the finest machine of its class, offering a speed range of 55-223 m.p.h. with unrivalled field of view. In the war years it proved a useful vehicle for delivering secret agents. Westland fighters, built subsequently, were the twin-Peregrine, low-altitude Whirlwind and the twin-Merlin, high-altitude Welkin. The Welkin was the largest single-seat fighter ever built, having a wing of 70ft span.

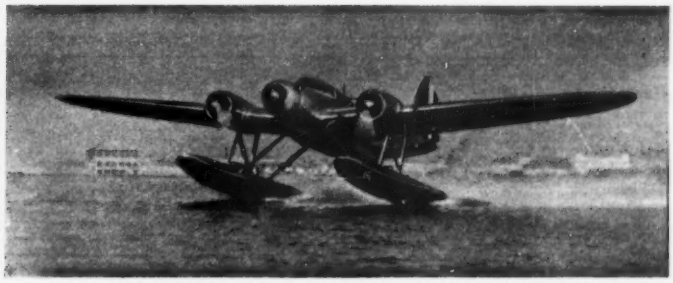
The radial-engined monoplane at **146** is the Bristol 138, and the fixed undercarriage is explained by the fact that this was a high-altitude research machine in which every pound of weight had to be saved. In 1936 the 138 reached the record height of 49,967ft, and in the following year a modified version ascended to 53,937ft.

1937 The Albatross airliner (**147**) was not the first four-engined de Havilland, for this had been the D.H. 86 biplane of 1933. It has, however, a strong claim to fame in that it was the cleanest four-engined machine of its day, and was able to cruise at 210 m.p.h. with only 320 h.p. being taken from each of its Gipsy Twelve engines.

A German effort in the same field was the Focke-Wulf Fw 200 Condor (**148**), later developed for military service and dubbed the "Tinfoil Bomber" by its aircrews.

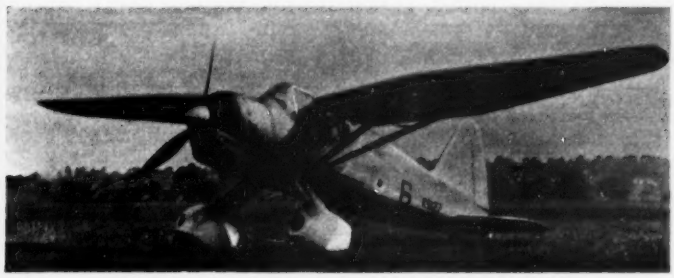


142 *World leadership for Britain—the Short Empire boat of 1936.*



143 *The Italians favoured floatplanes: shown is the Cant Z.506B (1936).*

144 *Prototype of the Catalina was the Consolidated XPBY-1 of 1936.*

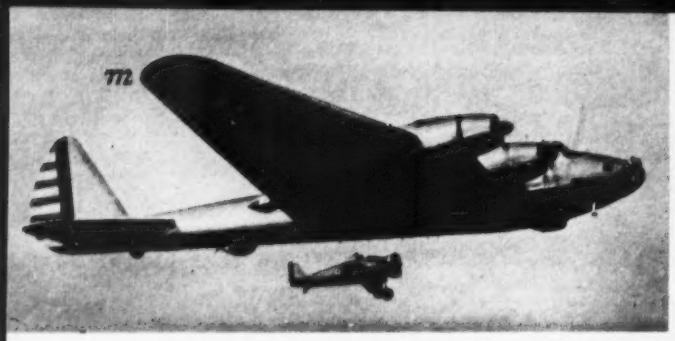


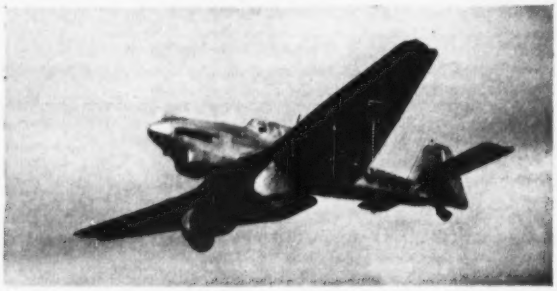
145 *Slotted and flapped—the Westland Lysander (1936).*

146 *A high altitude record-breaker of 1936—the Bristol 138.*

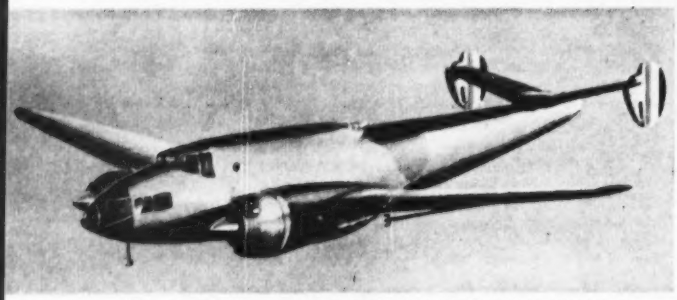
147 *In the Comet tradition—the de Havilland Albatross of 1937.*

148 *Liner—and commerce raider—the Fw 200 (1937).*

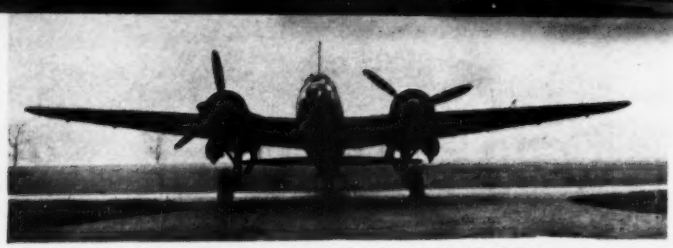




151 *An early version of the Ju 87 dive bomber (Stuka), 1937.*

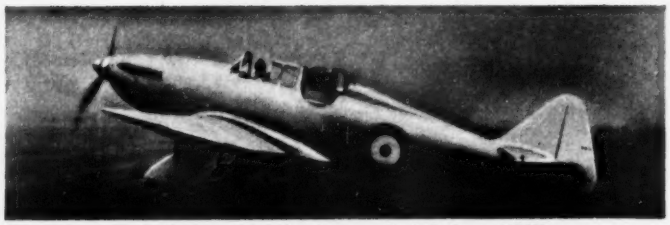


153 *French elegance epitomized—the LeO 45 bomber of 1937.*

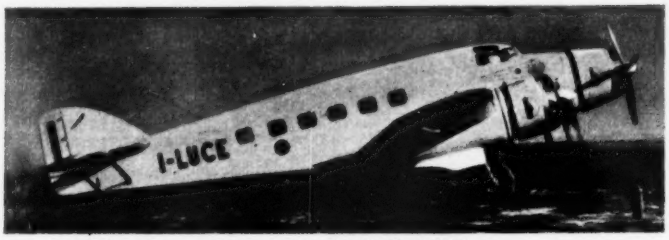


150 *(Above) A fine multi-purpose aircraft—the Ju 88 of 1937.*

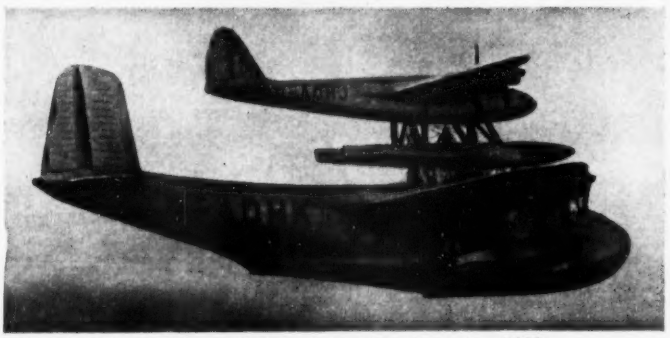
149 *(Left) Boeing YB-15 bomber and P-26 fighter (1937).*



152 *Turret-mounted armament—the Boulton Paul Defiant (1937).*



154 *A very fast airliner: the Savoia-Marchetti S.83 of 1938.*



155 *"Maia" and "Mercury" formed the Mayo Composite (1938).*

THE FIRST FIFTY YEARS . . .

(1937 Cont.) Some sharp contrasts in bomber design are to be seen on this page. At **149**, for instance (with a P-26 fighter to give it scale) is the Boeing YB-15, which was generally similar in layout to the YB-17 but of much larger dimensions (span 150ft). But, whereas the YB-15 was never to progress beyond the prototype stage, the YB-17 became world-famous as the Flying Fortress—mainstay, with the Consolidated-Vultee Liberator (and later with the B-29 Superfortress) of the U.S.A.F. strategic bombing force in the late war. Apart from its size the YB-15 had a certain technical interest in that it carried—for the first time on an aircraft—a 110-volt alternating-current electrical system, with generators driven by auxiliary petrol engines. The early Boeing bombers did not have power-driven turrets, although these were later introduced on the B-17.

The German imagination, unlike our own and that of America, was never really captured by the heavy, four-engined bomber, although, as we have previously noted, the Fw 200 was converted for military operations, and other four-engined types—notably the He 177—were used on a limited scale. The most common, and most successful, German bomber was, in fact, the twin-engined Ju 88 (**150**), a brilliant design in its way, though deficient in armament. The major part of the bomb-load was carried externally. Performance of developed versions was such that the "88" was successfully developed for night flying during the war years. The bomber version had wing-mounted dive brakes which enabled it to make dive-bombing attacks, though this method is usually associated with the single-engined Ju 87 (**151**). There is a popular belief that the Ju 87 was the first dive bomber, though this is far from being the case, for British fighters were aiming bombs in steep dives during the First World War. The same practice was successfully revived by the U.S. Navy several years later.

The French equivalent of the Ju 88, though not fitted for dive bombing, was the Lioré et Olivier LeO 45 (**153**). Judged even by modern standards this was an efficient machine.

The Boulton Paul company is chiefly famous for its bombers, but it has some interesting fighters to its credit, including the Bittern of 1928, in which the guns were movable in elevation, allowing attack from positions denied to fixed-gun machines. In 1937 came a far more significant development, namely the Defiant "turret fighter," in which the armament of four machine-guns was concentrated in a Boulton Paul power-driven turret, the mechanism whereof was of French origin. Although the Defiant saw brief, but spectacular, service at Dunkirk, it is chiefly famous as a night fighter over England.

1938 The twin searches for commercial speed and range are typified at **154** and **155** by the Savoia-Marchetti S.83 and the Short-Mayo Composite aircraft. In service with Sabena, the Savoia, with its cruising speed of 250 m.p.h., was the fastest airliner in the world. The upper component of the British composite machine—named *Mercury*—flew non-stop from Dundee to the Orange River, South Africa (6,045 miles).

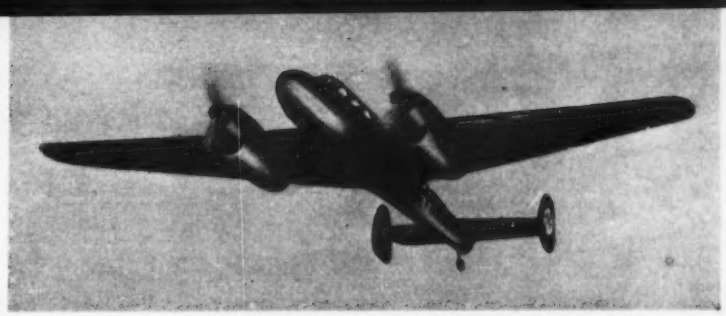
Last we show the North American BC-1, a forebear of the world-famous line of military trainers best known under the name Harvard. Machines of the same general type were built by the Commonwealth Aircraft Corporation Pty., Ltd., in Australia. They were the Wirraway general-purpose monoplane and the Boomerang single-seat fighter. The building of these types marked the beginning of large-scale aircraft production in Australia, where today Canberra bombers and Sabre fighters are coming off the lines.

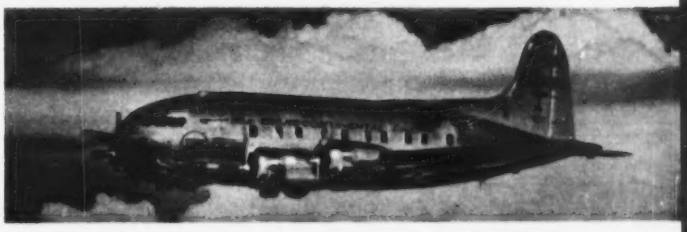
156 *Forerunner of the famous Harvard, North American BC-1 of 1938.*

157 (*Right*) *New fighter fashion: the Me 110 (1938).*

158 (*Below*) *The "helicopterish" Fieseler Storch (1938).*

159 (*Lower right*) *The pressurized Boeing Stratoliner, 1939.*





A new fashion in two-seater fighters, and one which was to persist longer than the turret formula exemplified by the Defiant, was set by the Messerschmitt Me 110, an early low-powered, Jumo-engined version of which is seen at **157**. With the more powerful Daimler-Benz engines, the "110" was widely used in the Battle of Britain, and served in subsequent campaigns as a day fighter, fighter/bomber, reconnaissance machine and night fighter. Towards the war's end very heavy armament was being installed to combat the massed formations of American daylight bombers. One scheme embodied two 30 mm, two 20 mm and two 7.9 mm guns.

Less fearsome, though a valuable second-line weapon, was the Fieseler Storch (**158**), used for liaison, communication and spotting by the German Air Force—and much prized by Allied officers who were fortunate enough to "win" a captured example.

Part IV The Hitler War (1939-1945)

1939 Before the deluge, we may consider a notable aircraft of peaceful intent and one which we suggest was the first truly modern airliner. This suggestion we base on the fact that it incorporated every essential feature of the inter-continental piston-engined airliner as we know it today, i.e., all-metal construction, supercharged engines, and pressurized cabin. The machine in question is the Boeing Stratoliner (**159**), eight of which were delivered to commercial operators and were taken up during the war by the U.S. Army Air Force. Just as the YB-15 bomber, illustrated on the opposite page, was closely related to the Boeing 314 Clipper flying-boat (which also rendered excellent war service) so was the Stratoliner akin to the B-17 Fortress.

The first purely military machine to be developed by the Lockheed Aircraft Corporation was the P-38 Lightning single-seat fighter (**160**). Among its numerous variants was a two-seater which carried a bomb aimer and led large formations of Lightning fighter/bombers, each carrying over 3,000 lb of bombs. Some models were equipped for reconnaissance. It was on the Lightning that the phenomenon of compressibility was first experienced in a marked degree.

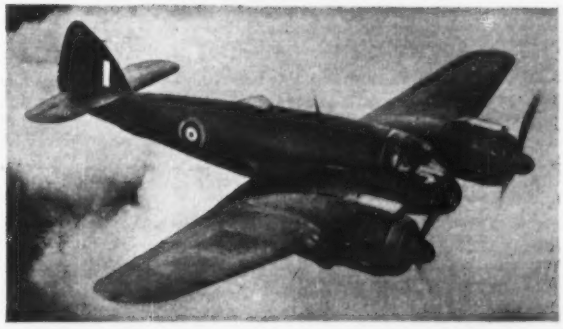
The most famous night fighter of the late war (and almost equally famous as a torpedo fighter) was the Bristol Beaufighter (**162**), developed in a few months from the Beaufort torpedo bomber. It was on the "Beau" that A.I. radar was first introduced on a large scale as standard equipment.

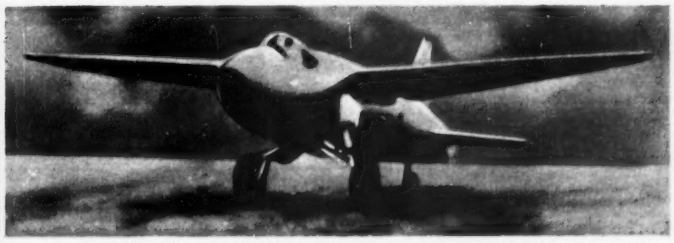
The picture at **161** is small in size and indifferent in quality, yet it shows a very significant aeroplane indeed. It is the Heinkel He 178, which, on August 27th, 1939, made the first flight by a turbojet-propelled aircraft. The power unit, an HeS3B, was mounted behind the pilot and fed from a nose intake. We may record here also that an He 112 fighter had earlier become the first aircraft to fly successfully on rocket power alone.

The two four-engined bombers at **163** and **164** are the Handley Page Halifax and Consolidated XB-24 (Liberator prototype)—both of them war-winners in the first degree.

Though the Liberator was principally used as a bomber, it also served with our own Coastal Command as a long-range ocean-patrol aircraft. Many machines of the type were also adapted for transport, and some of Mr. Churchill's most famous war-time journeys were made in the "Lib." A development is still in service with the U.S. Navy.

160 *The first of thousands—prototype Lockheed Lightning (1939).*



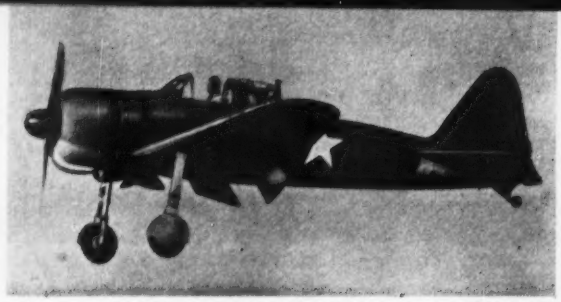


161 *The world's first turbojet aircraft was the He 178 of 1939.*

162 (*Right, above*) *The pugnacious Bristol Beaufighter of 1939.*

163 (*Below*) *In the O/400 tradition—the Handley Page Halifax of 1939.*

164 (*Right*) *The first Liberator (Consolidated XB-24 of 1939).*



165 *Surprise in the Pacific—the "Zero" (1940) seen in U.S. markings.*

166 *The Blackburn B.20, of 1940, had a retractable planing bottom.*

THE FIRST FIFTY YEARS . . .

1940 Two fighters which gave the Allies some of their biggest surprises, and some of their most serious worries, were both radial-engined. They were the Japanese Mitsubishi Navy Type O (**165**), dubbed "Zero" by the Americans, and the German Focke-Wulf Fw 190 (**168**). Both excelled in manœuvrability, but whereas the "Zero" achieved this in part at the expense of armour and equipment, the Focke-Wulf was a first-rate fighter in every respect. A notable contribution to its performance was made by the installation of the B.M.W.801 engine in a very compact low-drag cowling, with induced fan-cooling.

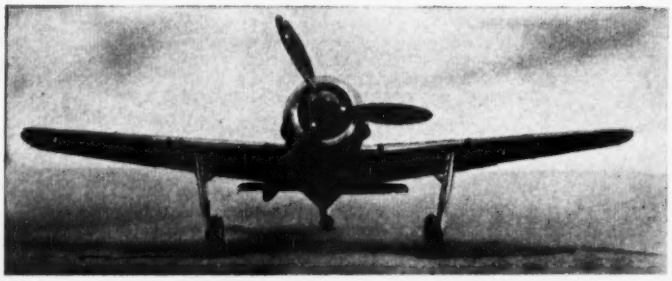
Another unorthodox German engine installation was made in the Heinkel He 177 bomber (**167**). Although apparently twin-engined, it had, in fact, four engines, grouped in two pairs, each pair driving one airscrew. A clutch enabled either engine of a pair to be uncoupled.

In addition to standard machines we have on this page two experimental types. The Blackburn B.20, illustrated at **166**, was built to exploit a patented retractable planing bottom, but though it was flown in 1940, an accident put an end to further development. A more fruitful experiment was the Vought-Sikorsky 300 helicopter (**169**)—a flying test-bed which provided basic data for successive—and successful—types.

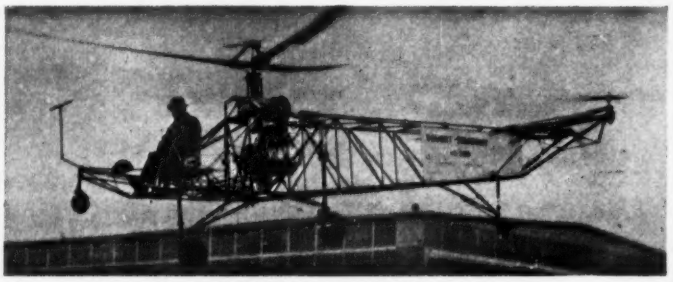
Side by side we have two very famous products of the North American company—the Mustang fighter (**170**) and the Mitchell bomber (**171**). The Mustang was built to a British specification and, although initially powered with an Allison engine, achieved the zenith of its fame with the Rolls-Royce Merlin. Teamed with Lockheed Lightnings and Republic Thunderbolts, Mustangs undertook bomber escort duties and fighter/bomber operations deep into enemy territory. The Mitchell was, perhaps, the most successful twin-engined tactical bomber available to the Allies, though hardly less famous were the Martin Marauder and Douglas Boston and Havoc.

Among the "heavy" bombers of the war, the laurels, in our own submission, go to the Avro Lancaster (**172**), designed by Roy Chadwick. Here was a machine in which British compromise was exercised to brilliant effect. There were several versions, but typically the "Lanc." had a top speed of about 275 m.p.h., was armed with eight 0.303in guns in three turrets, and carried about eight tons of bombs. A few were adapted to carry the 22,000 lb "Grand Slam" bomb or anti-dam weapons.

167 *Another in captivity—the four-engined He 177 (1940).*

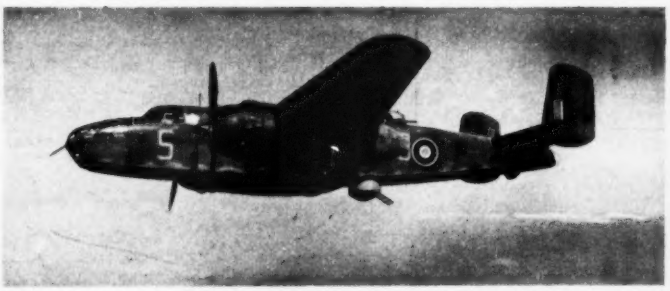


168 *Under development during 1940 was the formidable Fw 190.*



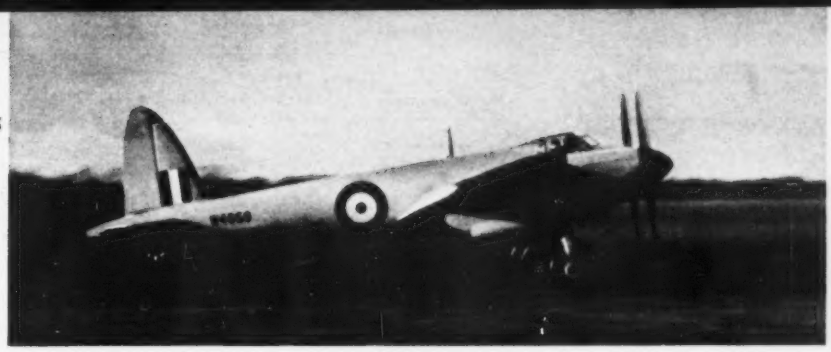
169 *Igor Sikorsky's famous VS-300 helicopter of 1940.*

170 *Developed to a British "spec."—the N.A. Mustang of 1940.*

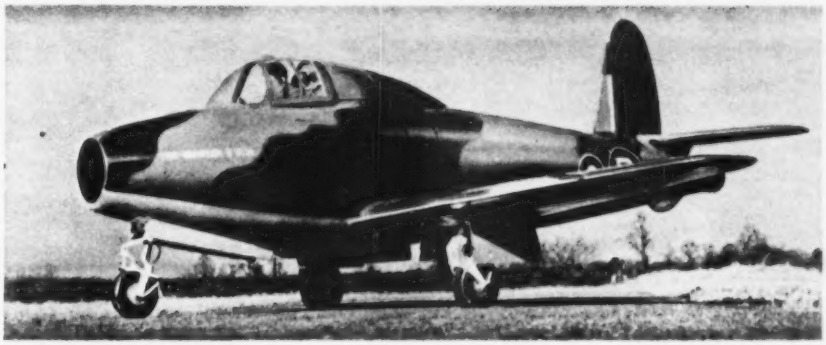


171 *An eminent tactical bomber—the N.A. Mitchell, dating from 1940.*

172 *Britain's most famous bomber—the Avro Lancaster (1940). Note the wide field of fire commanded by the powered turrets.*

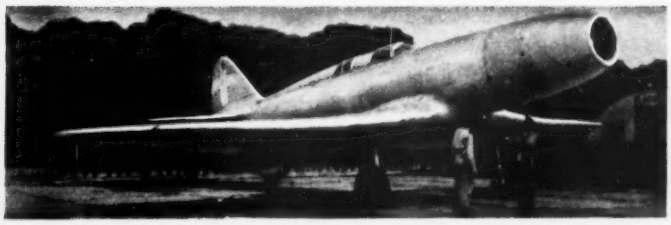


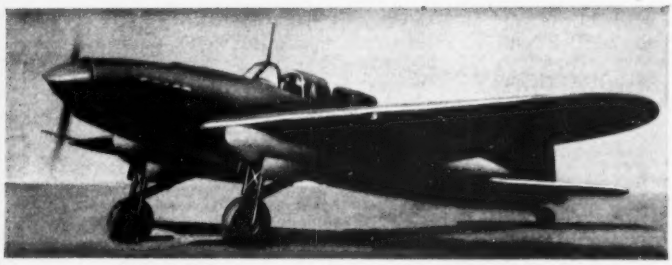
173 *The most versatile military aircraft ever built was the de Havilland Mosquito, shown as it first appeared in November, 1940.*



174 *Britain's first turbojet aircraft was the Gloster-Whittle E.28/39. Maiden flight, May 15th, 1941.*

175 *(Below) Caproni-Campini C.C.2 (1941).*





176 *(Middle view above) The graceful Latecoere 631, of 1941.*

177 *Immediately above is the Ilyushin Stormovik (1941).*

178 *(Right) Doblhoff's tip-jet helicopter (1942).*

180 *(Lower right) The giant Me 323 dated from 1942.*

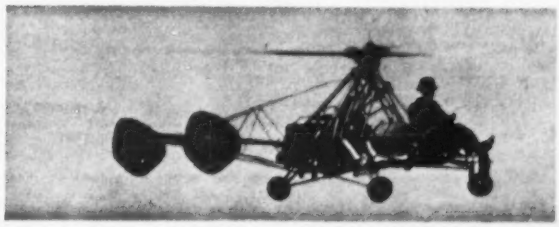
179 *(Below) The Chance Vought V-173 "pancake" of 1942.*

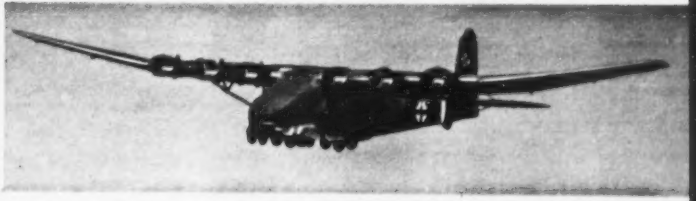
We have captioned the de Havilland Mosquito (**173**) as "the most versatile military aircraft ever built"; and assuredly it was. It first flew as an unarmed bomber in November 1940, and thereafter was adapted as a day fighter, for ocean patrol, as a night intercepter, day and night intruder and fighter/bomber, day and night bomber (carrying in some cases a 4,000 lb "block-buster"), pathfinder and high-speed transport. Illustrative of performance are these figures for the P.R.34: top speed, 425 m.p.h.; cruising speed, 315 m.p.h. at 30,000ft; range, over 3,500 miles. A single-seater along Mosquito lines was the Hornet, and both this and the "Mossie" had carrier-borne versions.

1941 The Mosquito is in good company, for figure **174** shows the Gloster-Whittle E.28/39—the first British turbojet-propelled aircraft to fly (on May 15th, 1941) The E.28/39 was far more successful than the Heinkel He 178, which, as we have recorded, flew earlier—on August 27th, 1939. Another foreign jet aircraft to fly before the little Gloster was Italy's Caproni-Campini, first airborne on August 27th, 1940. This, however, was not a turbojet machine, but had a piston engine to drive its compressor, as had the C.C.2 (**175**) which flew from Milan to Guidonia, near Rome, on December 1st, 1941.

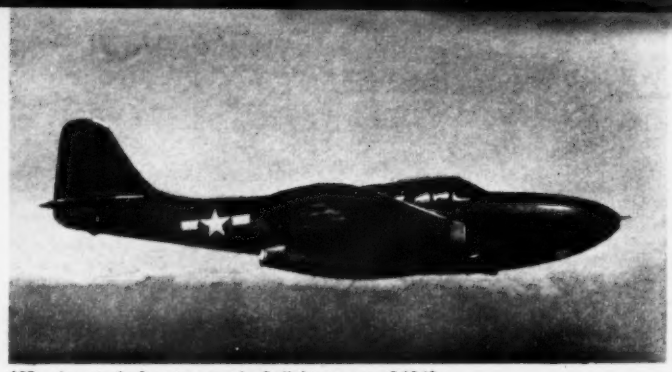
The graceful flying-boat at **176** is the Latécoère 631, designed before, built during, and operated after, the war. Fig. **177** shows the Russian Il-2 Stormovik, a heavily armoured ground-attack aircraft which wrought great execution among the German invaders. The concept was not new, for our Sopwith Salamander "trench fighter" of 1918 carried some 650 lb of armour plate.

1942 The Austrian Doblhoff helicopter (**178**) was the first to have a jet-operated rotor; the Chance Vought V-173 (**179**) was a model for an experimental fighter, having a wing of approximately circular plan-form and designed to hover, by virtue of its special airscrews; and the Messerschmitt Me 323 (**180**) was a powered version of the Me 321 "invasion" glider. These German colossi did not demand super-marksmanship from the Beaufighter pilots who potted them over the Mediterranean.



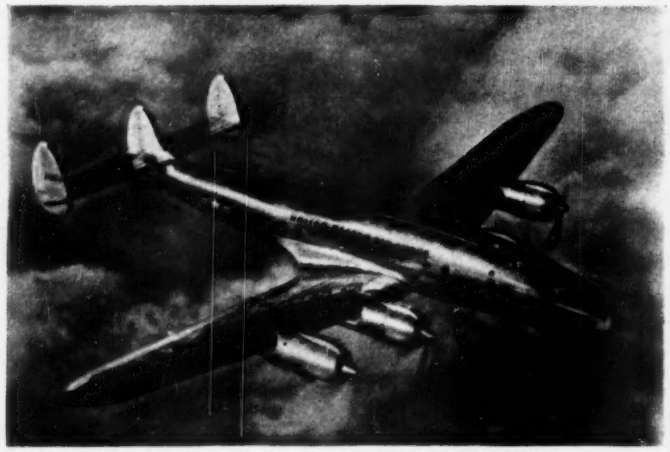


181 *A superb American bomber—the Boeing B-29 of 1942.*



182 *America's first jet was the Bell Airacomet of 1942.*

183 *A Douglas Skymaster of the U.S.A.F. The type dated from 1942.*



184 *Internationally famous—Lockheed's Constellation, flown in 1943.*

THE FIRST FIFTY YEARS . . .

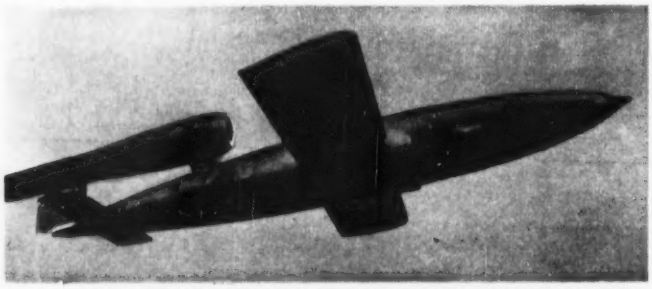
(1942 Cont.) Each of the four pictures above depicts a notable American machine. At **181** is a Boeing B-29 Superfortress, the first pressurized bomber to see active service on a large scale, though the Germans had used a few pressurized Ju 86Ps and the R.A.F. had operated Wellingtons fitted with a boiler-like pressure cabin. It was a B-29 which was destined to shake the foundations of our civilization, and to precipitate the surrender of Japan, by dropping the first atomic bomb, on Hiroshima. The B-29 and its successor, the B-50, were notable, too, for the ingenious fire-control system applied to their remotely aimed gun barbettes. In 1949 a B-50 flew non-stop round the world, having refuelled over the Azores, Arabia, the Philippines and Hawaii with the aid of British-designed Flight Refuelling equipment. The distance of 23,108 miles was covered in 94 hr 1 min.

America's first jet-propelled aircraft was the Bell Airacomet (**182**), powered with two Whittle-type turbojets. A few production machines, carrying fighter armament, were delivered.

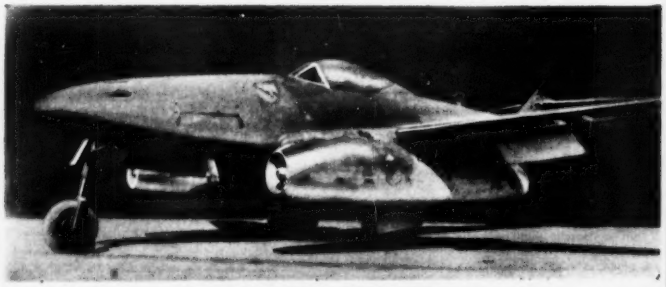
Two transports which have rivalled and supplemented each other in military and civil operation are the Douglas Skymaster (**183**) and Lockheed Constellation (**184**). Both have made magnificent contributions to the opening-up of world air routes and each has a successor, in the DC-6 and Super-Constellation respectively. The U.S.A.F. version of the Skymaster is designated C-54 and it was a machine of this type which, in September, 1947, flew the Atlantic entirely under automatic control.

1943 Mention of automatic control reminds us that the loathsome German V-1 flying bomb (**185**) was simply an automatically controlled pilotless aircraft. Developed originally by the Fieseler concern, it was powered by a pulse-jet, and was thus the first jet-propelled aircraft to be used operationally. The first turbojet piloted aircraft in service was the Me 262 (**186**), powered with two Junkers Jumo 004s. Prototypes flew in 1942, though most of the development work was under way in 1943/1944.

Britain's first Service-type jet was the Gloster Meteor, originally known by its specification number F.9/40. The first F.9/40—with Halford units—is shown at **188**. Early Meteors were in action against V-1s and the Mk 8 version is today the most widely used R.A.F. fighter. America's first operational jet was the Shooting Star (first flown early in 1944), the first example of which is shown at **187**. A Shooting Star was the first piloted aircraft to fly solely on ramjet power. Fighter/bomber versions

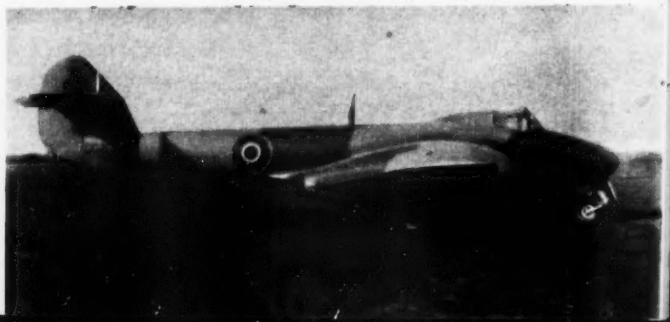


185 *The infamous V-1 flying bomb was being developed in 1943.*



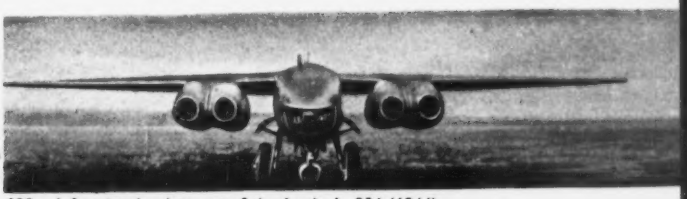
186 *The Messerschmitt Me 262, also under development in 1943.*

187 *The Lockheed Shooting Star (1944) was to fight in Korea.*

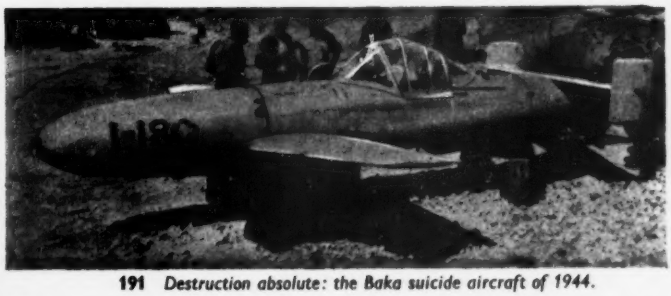


188 *The first Gloster F.9/40 (later the Meteor) to fly—in 1943.*

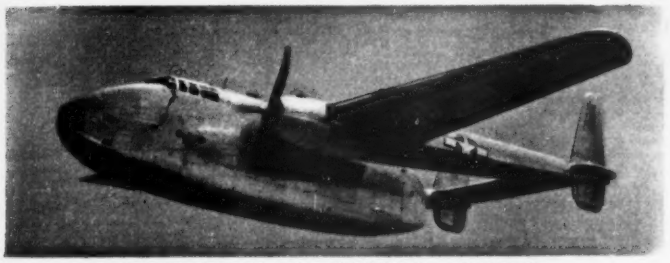
189 *Twin-boom, single-jet—the compact de Havilland Vampire (1943).*



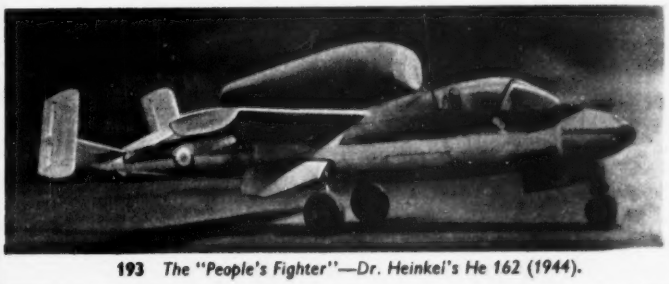
190 *A four-jet development of the Arado Ar 234 (1944).*



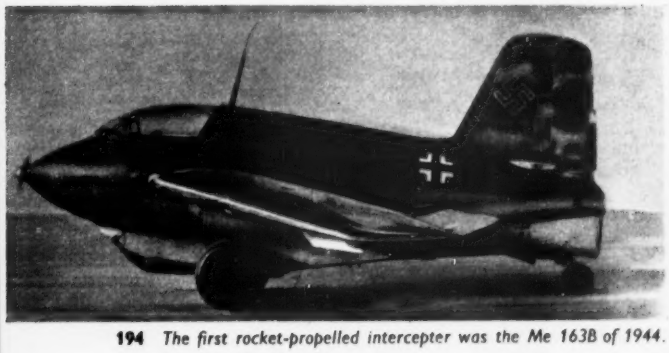
191 *Destruction absolute: the Baka suicide aircraft of 1944.*



192 *The Fairchild Packet of 1944 had rear-loading doors.*



193 *The "People's Fighter"—Dr. Heinkel's He 162 (1944).*



194 *The first rocket-propelled intercepter was the Me 163B of 1944.*

195 *Four jets and forward sweep: the Ju 287 of 1945.*

were employed to excellent effect in the Korean campaign.

When it first flew in 1943 the de Havilland Vampire jet fighter (**189**) was known as the Spider Crab by reason of its twin-boom layout. Of remarkable compactness, the Vampire is generally powered with a Goblin turbojet, likewise of D.H. manufacture. It has displayed the characteristic de Havilland propensity for development, and the single-seat intercepter version was succeeded by the Sea Vampire (an early model of which underwent deck-landing trials late in 1945), by fighter/bomber adaptations and by two-seat versions for training and night fighting. With a new and thinner wing, a Ghost turbojet and other refinements the Vampire became the Venom, and of this basic type, in turn, single-seat and two-seat versions are now in large-scale production.

1944 While the Vampire did not see service in the late war, a contemporary German machine, the Arado Ar 234 was operated on a limited scale. The four-jet version shown at **190** (234s were mostly twin-jet) was designed for a speed approaching 550 m.p.h.

Although it is true that the Germans developed a piloted version of the V-1, and that the Japanese made suicide attacks with standard types of aircraft, the first machine designed for, and used for, suicide tactics was the Baka (**191**). This was launched from a bomber at about 27,000ft and glided towards the target. Rockets were then ignited, and in the final aiming dive the speed could reach 600 m.p.h. or more. The warhead weighed over 2,500 lb.

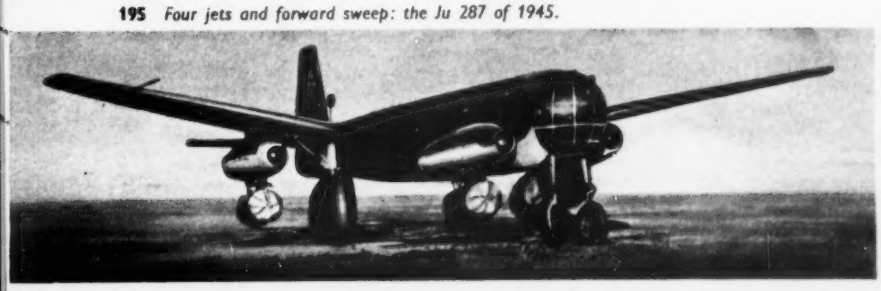
It is pleasant, after considering this terrible weapon, to turn to a transport aircraft which, although built for military use, has contributed much to the alleviation of human distress, as, for instance, on the Berlin air-lift. The machine is the Fairchild Packet, an early (C-82) version of which is illustrated at **192**. A particularly valuable feature is the provision of doors at the rear, whereby bulky items can be loaded, unloaded, or parachuted. An experimental development, known as the Pack Plane, has a completely detachable fuselage—a feature incorporated in the Miles M.68 of 1947.

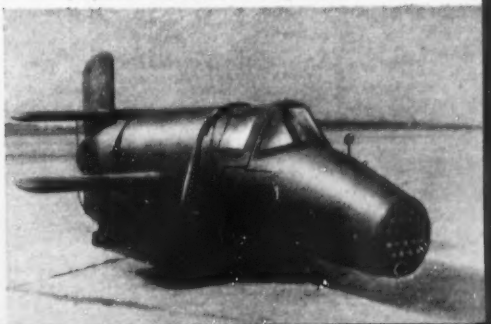
For many years fighter-designers have essayed a machine in which small dimensions and low weight (and, consequently, low cost) have been dominant considerations. Such a machine was the Heinkel He 162 "People's Fighter" (**193**). Designed to employ as little "strategic" material as possible, it had a span of only 24ft but carried the very useful armament of two 30 mm guns (the heavier twin-jet Me 262 had four of these weapons). Had German production—and the war—continued, there is little doubt that He 162s would have been a serious menace to Allied bombers. A few were operational, but in lesser numbers than the Me 163B (**194**), which was the first rocket-propelled fighter to be used in action. It took off from a jettisonable chassis and was propelled to 30,000ft by its Walter liquid rocket in little more than 2½ minutes. Its ceiling was over 50,000ft. Duration under power was less than 10 minutes but endurance could be extended by periods of gliding.

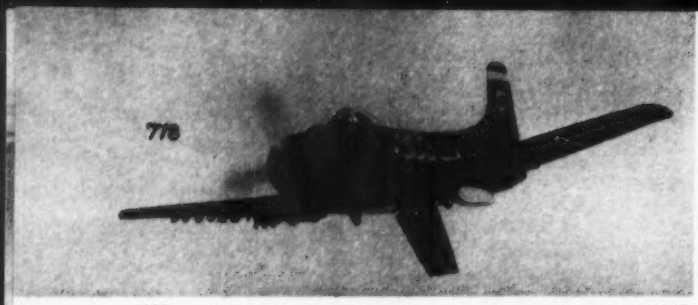
1945 The Junkers Ju 287 (**195**) was the first large multi-jet bomber and is of interest in that the wing was swept forward. Although it is commonly supposed that this was the first instance of forward sweep, research discloses that the American Hurlburt built (but not flown) in 1910, was similarly distinguished.

The Bachem Natter (**196**) was a semi-expendable, rocket-propelled and rocket-armed "local defence" intercepter, to be launched from a tower-like structure with the assistance of auxiliary rockets and to climb at the rate of 37,000ft/min.

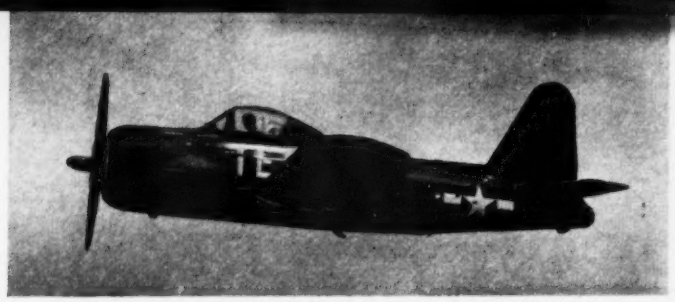
196 *Vertical take-off: the rocket-propelled Bachem Natter of 1945.*



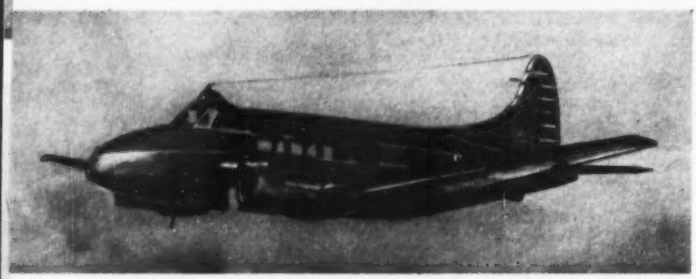




197 *A "slugger" of the U.S. Navy—the Douglas Skyraider, 1945.*



198 *With piston engine and turbojet: the Ryan Fireball of 1945.*

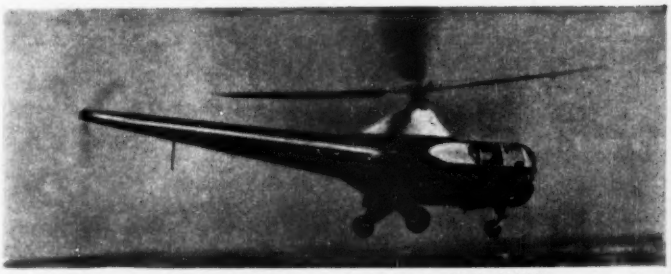


199 *Carrying the olive branch—the D H. Dove of 1945.*

200 *First turboprop aircraft to fly was the Trent-Meteor of 1945.*

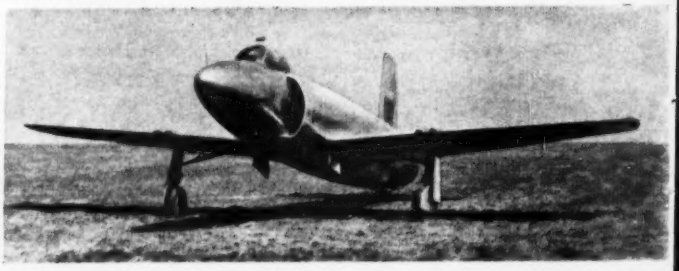
201 *(Below) Known the world over is the Bell 47 helicopter (1945).*

202 *With nose-opening doors: the Bristol Type 170, of 1945.*



203 *Another world-famous helicopter is the Sikorsky S-51 (1946).*

204 *(Below) A sire of the supersonic Swift: Supermarine E.10/44 1946.*



THE FIRST FIFTY YEARS . . .

(1945 Cont.) The great Douglas concern has tried its hand at most classes of aircraft, and at **197** is shown their Skyraider, which ranks as one of the most successful carrier-borne machines ever put into service. Primarily designed for "strike," it also serves as a radar countermeasures aircraft, for early warning, and even for transport. The dive brakes (seen extended above) comprise three sections of the fuselage. Beneath the wings and fuselage are slung the various offensive "stores," totalling up to 6,000 lb and including such items as bombs, rockets, napalm tanks and torpedoes. The Skyraider is a type which we have welcomed into service in this country, as we have the Lockheed Neptune, holder of the world's long-distance record of 11,235 miles.

A third U.S. Navy machine—the Ryan Fireball, at **198**—was powered with a piston engine and a turbojet; and when the former went unserviceable on one occasion in November, 1945, a Fireball became the first jet-propelled aircraft to land aboard an aircraft carrier. A development had a turboprop instead of the piston engine—was, indeed, one of the earliest machines to use turboprop power; but it flew later than Britain's Trent-Meteor (**200**)—indisputably the first turboprop aircraft to take the air (in September, 1945). After being privileged to fly this historic aircraft early in 1948, the Editor of this journal remarked: "Except for the very highest air speeds, the airscrew-turbine has many good features . . . most of its control problems are well on the way towards satisfactory solution."

Just as the old de Havilland Dragon was a miniature airliner, so are the company's post-war Dove (**199**) and its larger four-engined development, the Heron. Not the least gratifying aspect of the Dove's success is its ready sale in America.

At **201** we show the Bell 47, a helicopter which, in the immediate post-war years, has done much to open up the vast field of helicopter operation, which still extends before us.

Part V The New Thrust (1946-1953)

1946 Sikorsky's contribution to post-war "helicopting" was the S-51 (**203**), licence-built in this country by Westland Aircraft, Ltd., and a wholly British contribution to commercial flying was the Bristol 170 (**202**), now seen in many countries.

next , at **204** and **205**, we have two straight-wing jet fighters of 1946 which have rendered good service in their own right and have provided the basis for swept-wing developments of far higher performance. They are the Supermarine E.10/44 (Attacker) and Republic Thunderjet, and their modern descendants are the supersonic Swift and Thunderstreak.

205 *Famed in Korea: the Republic Thunderjet, flown in 1946.*

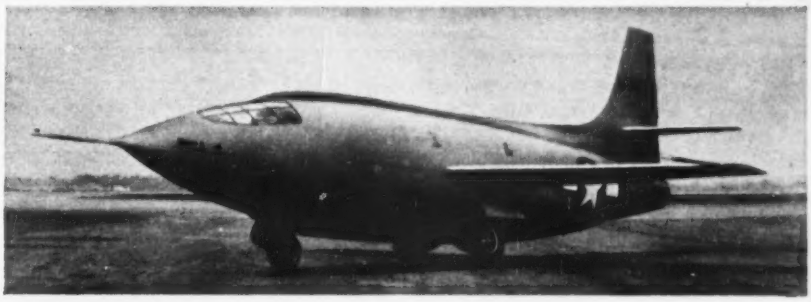
206 *de Havilland D.H. 108 (1946).*

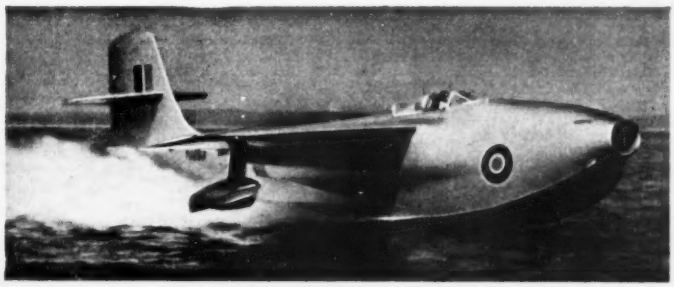
207 *(Top right) Convair B-36 (1946).*

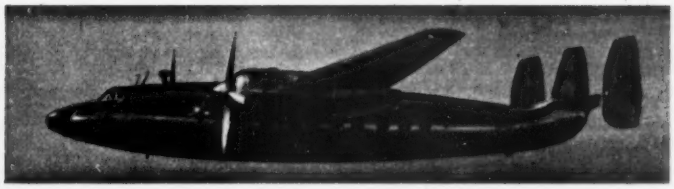
208 *(Right) Bell X-1 (1946).*

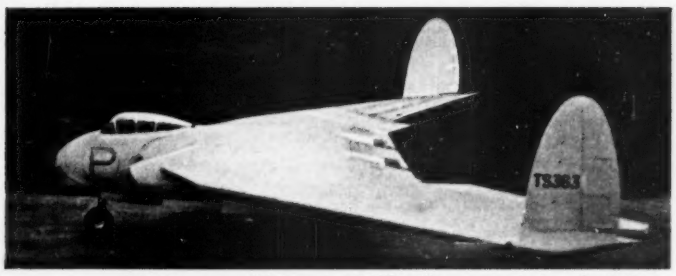
209 *(Below) Saunders-Roe S.R./A.1 (1947).*

210 *(Centre, below) Airspeed Ambassador (1947).*









211 *Armstrong Whitworth A.W.52 tailless research aircraft of 1947.*

212 *(Right) "Pods" and "bicycle" undercarriage: the Boeing B-47 (1947).*

213 *Surprise over Korea: the Mig-15, first flown 1947.*

For design diversity and technical interest this page is certainly one of the most remarkable in our review to date. The swept-wing, semi-tailless machine at **206** is the D.H. 108, built, in the light of German research experience, to provide aerodynamic data for the Comet airliner. It was the first British aircraft to achieve supersonic speed in the dive; but the Bell X-1 (**208**) was the first in the world to exceed the magic "Mach 1." A straight-wing machine with conventional controls, the X-1 was powered by a four-barrelled bifuel rocket motor of 6,000 lb thrust and was usually air-launched. Limits attained with this historic aircraft were: Mach 1.5 (1947); 967 m.p.h. (1948); 70,140ft (1949).

The mightiest bomber ever built—and built in large numbers into the bargain—is the Convair B-36, the prototype of which is shown at **207**. As depicted, the type was powered with six Wasp Major engines, but to this basic power plant were later added four underslung turbojets. Top speed is well over 400 m.p.h.

1947 A British "first," marked by the photograph at 209, was the Saunders-Roe S.R./A.1 fighter flying-boat—the earliest jet-propelled, water-based aircraft. Metrovick Beryls provided power.

Whereas the post-war American transports such as the Convair 240 and Martin 2-0-2 were of the familiar low-wing layout, the British Airspeed Ambassador (**210**), has a high wing.

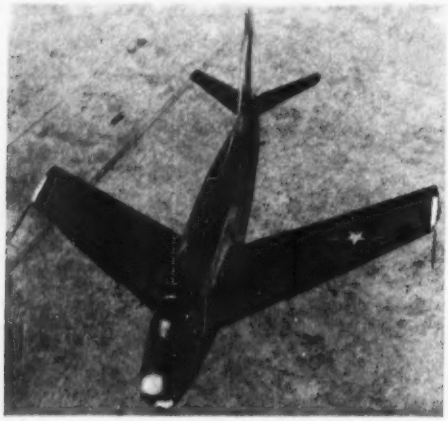
The A.W.52 (**211**) was built to investigate the characteristics of jet-propelled tailless aircraft, and the Fairey Gyrodyne (not shown) was the fastest helicopter of its day. It was distinguished from its contemporaries in having an off-set tractor airscrew in place of the familiar anti-torque rotor. This screw also enabled the machine to be flown as an autogiro.

What the Fokker monoplane was in the First World War, and the Fw 190 and "Zero" were in the Second, so was the Germano/Russian Mig-15 (**213**) in the Korean campaign. Powered with a development of the Rolls-Royce Nene, it is armed with one 37 and two 23 mm guns, and although its high-speed characteristics are inferior to the Sabre's, it proved to have a disconcertingly high performance.

Startling features of the now-famous Boeing B-47 bomber (**212**) were its flexible wing, "podded" jets and "bicycle" undercarriage. Over 700 have been built. The later, eight-jet B-52 is far larger (span 185ft) but of similar layout.

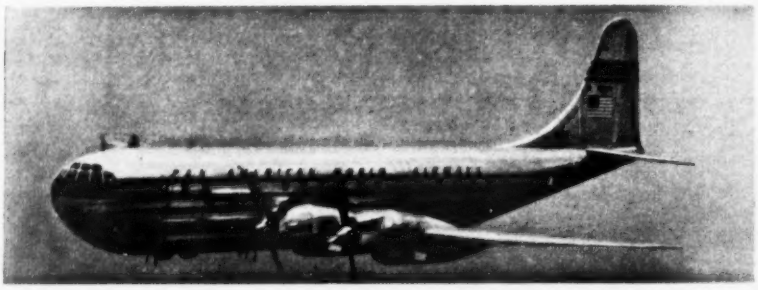
214 *The ramjet-powered Leduc O.10 (1947) and its "mothership."*

215 *Largest heavier-than-air craft: the Hughes Hercules of 1947.*



217 *Korean victor: the North American Sabre (1947).*

216 *Wellsian in concept was the Northrop YB-49 bomber of 1947.*



218 *(Right) Post-war liner: Boeing Stratocruiser of 1947.*

THE FIRST FIFTY YEARS . . .

(1947 Cont.) We have recorded the claim that the Lockheed Shooting Star was the first aircraft to fly solely under ramjet power; but France, too, has been active in ramjet research with the Leduc O.10 (**214**) seen being borne aloft on the back of its Languedoc "mothership." (The Languedoc is a post-war French transport machine.) An improved Leduc, the O.21, should have a rate of climb of 40,000ft/min and even at 45,000ft still be able to ascend at 4,000-5,000ft/min.

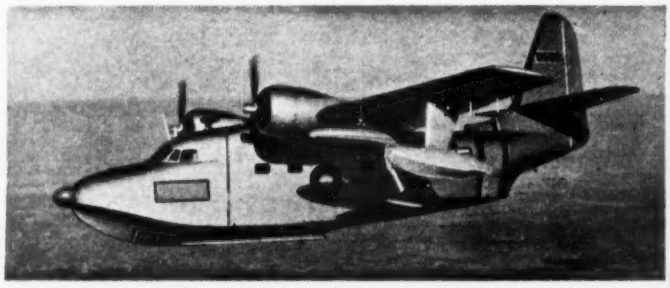
The largest heavier-than-air craft ever built is the Hughes flying-boat, sometimes known as the Hercules and shown at **215**. Not the least remarkable aspect of this monster, which has a span of 320ft and a length of 219ft, is its all-wooden construction. The power plant is eight Pratt and Whitney Wasp Majors of about 3,000 h.p. each, and the gross weight about 400,000 lb. Up to 700 passengers might be carried. The boat was launched in November, 1947, and forthwith made its one and only "hop."

The smoke-trailing "flying wing" at **216** is Northrop's eight-jet YB-49, a very courageous bomber experiment subsequent to the piston-engined XB-35. Although this jet bomber is the first Northrop product we have illustrated, it must go on record that the makers had been noted for many years previously as constructors of high-performance aircraft. Among these were single-engined transports and tailless fighters, including one with a prone-pilot position. Current types are the straight-wing, twin-jet Scorpion all-weather fighter, in U.S.A.F. service, and the X-4 swept-wing, semi-tailless research aircraft.

German design theory and American constructional and control techniques were combined in the North American Sabre single-seater (**217**) to produce a machine of quite exceptional merit. Of all the Allied fighters available for the Korean campaign, this was the only one which could engage the Russian Mig-15s on equal terms. Design features included 35-deg sweepback on the mainplanes (measured on the 25 per cent chord line) and "sandwich" type wing construction, whereby the structural material was laminated between the inner and outer tapered skins. On the "E" variant the "all-flying" tail was introduced. This expression implies that the tailplane and elevators are linked for co-ordinated movement, thereby giving the better longitudinal control and eliminating the loss in effectiveness of the surfaces due to the heavy loads at extreme speeds. Another innovation on the "E" was the irreversible power-control system, in which none of the actual air loads act upon the control column. For all-weather work the "D" variant has radar—and a retractable launcher for its all-rocket armament.

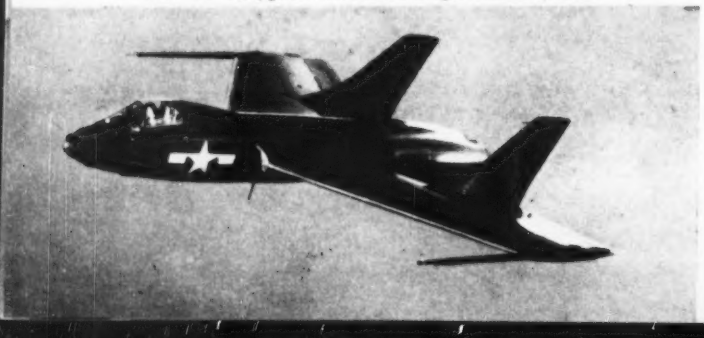
When the Boeing company set about transforming the basic B-29 bomber design into a transport it became necessary to adopt the "double bubble" fuselage configuration, seen in the view of the Stratocruiser at **218**.

1948 The Grumman Albatross (**219**) is similar in lay-out to other amphibians, including our own Short Sealand. The Chance Vought Cutlass of the U.S. Navy (**220**) is the first tailless aircraft to be adopted for service; and last on this page is Britain's experimental three-rotor Cierva Air Horse (**221**), biggest helicopter of its day. The engine was a Rolls-Royce Merlin.

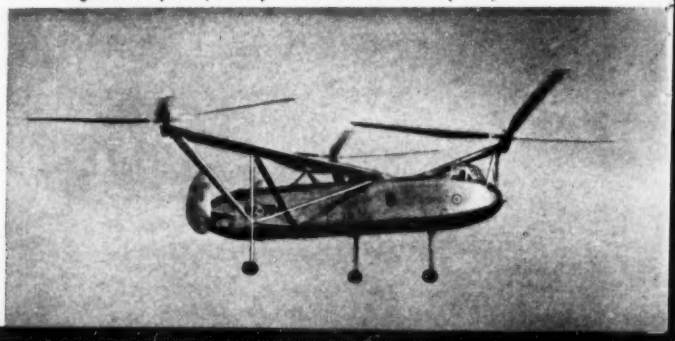


219 *The Grumman Albatross (1948) flies from land, water, ice, or snow.*

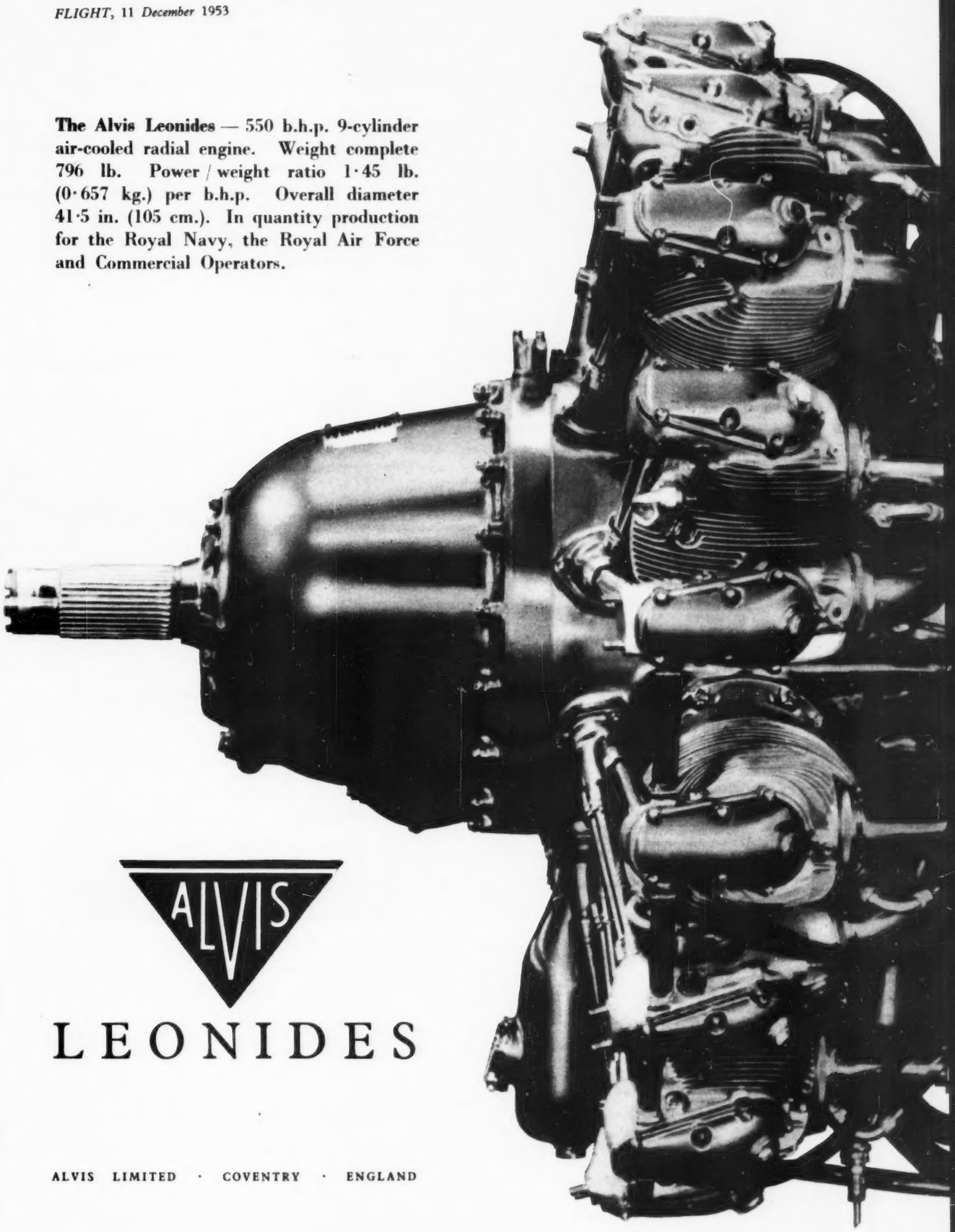
220 *Tailless fighter: the Chance Vought Cutlass of 1948.*



221 *Largest helicopter of its day: the Cierva Air Horse (1948)*



The Alvis Leonides — 550 b.h.p. 9-cylinder air-cooled radial engine. Weight complete 796 lb. Power / weight ratio 1·45 lb. (0·657 kg.) per b.h.p. Overall diameter 41·5 in. (105 cm.). In quantity production for the Royal Navy, the Royal Air Force and Commercial Operators.



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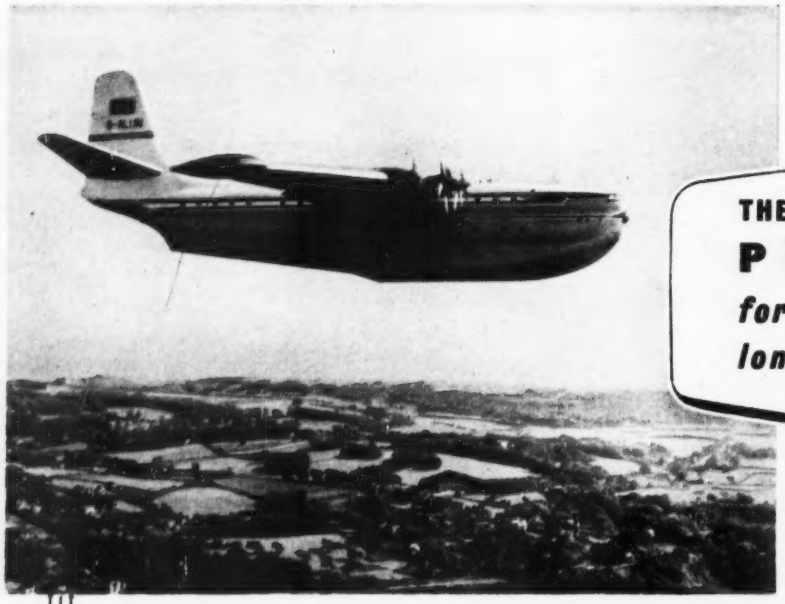

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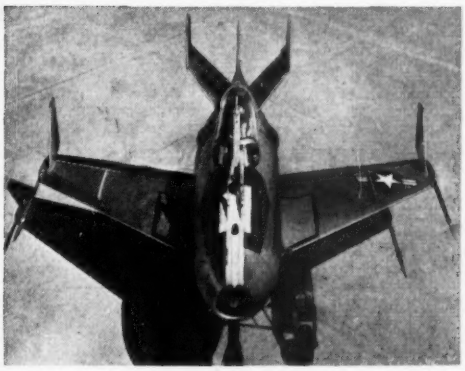
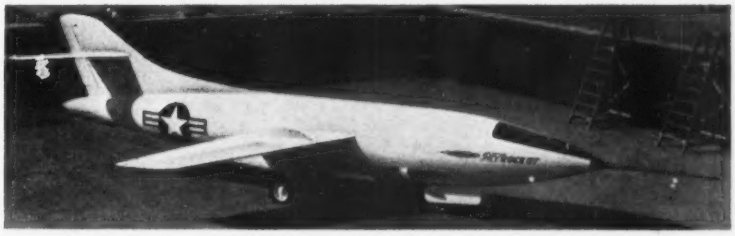
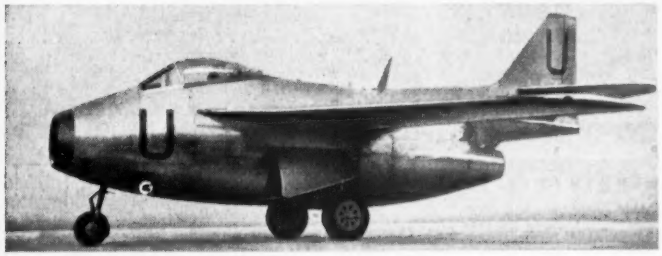




222 *McDonnell XF-85 "parasite" fighter (1948)*
223 *(Top right) Vickers Viscount (1948).*
224 *(Right) Douglas Skyrocket (1948).*
225 *(Below) Saab J-29 (1948).*



226 *France's double-decker: the Bréguet Deux-Ponts of 1949.*

When *Flight* wished success to the Vickers-Armstrongs Viscount, on the occasion of its entry into service early in 1953 we remarked that speed, comfort, economy and safety (in reverse order of importance) were all to be found in it in generous measure. This is largely due to the Rolls-Royce Dart turboprops—and it is the Viscount (**223**) that we acclaim as the world's first turboprop airliner. With such fine aircraft of our own we can afford not to stint our praise of the Americans for their sponsorship of such amazing machines as the Douglas Skyrocket (**224**). As long ago as 1951 a Skyrocket exceeded 1,200 m.p.h. and attained a height of 75,000ft; and during this year an altitude of 83,235ft and a speed of 1,272 m.p.h. (representing a Mach number of 1.96) have been claimed for a similar machine.

From this pioneer research aircraft we glance at two fighters—the McDonnell XF-85 (**222**), designed as a parasite for the protection of large bombers—from which it was air-launched—and Sweden's Saab J-29 (**225**), a swept-wing fighter which ranks next to the Sabre and Mig-15.

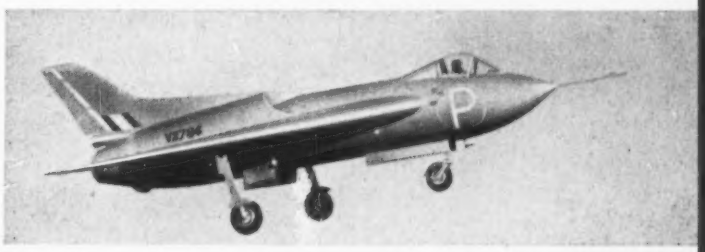
1949 The diligent reader will remember our reference far back to the Bréguet *Coffee Pot*, which carried six people in 1910, and will thus turn to the Bréguet Deux-Ponts (**226**) with the greater interest, for this type seats 59 passengers on the upper deck and 49 on the lower.

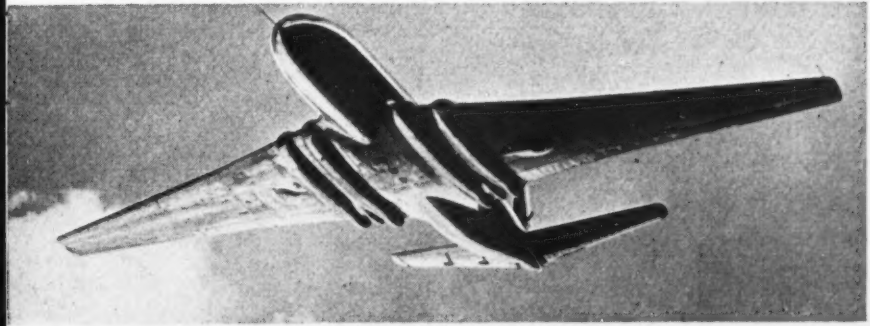
Although the advantages of the delta wing were first pointed out by the German Lippisch, it was in this country that this design was first exploited to the full—in the Avro Vulcan bomber, later illustrated. At **227** is shown the first of a series of Avro 707 research aircraft—scale models of the great bomber.

The dainty little jet at **228** is the Cyclone, one of a series of Fouga monoplanes designed for the tiny Turboméca jet units.

Having headed the page with the world's first turboprop airliner, we foot it with the de Havilland Comet (**229**)—the first airliner with turbojet power. The Series 1A Comets have four de Havilland Ghost centrifugal turbojets, but in the Mk 2 version these are replaced by axial Rolls-Royce Avons. It has justly been claimed for the Series 1 and 1A Comets that they have achieved a revolution in air transport by virtually doubling normal operating speeds without economic penalty. Comet travel has been summed up by the chairman of B.O.A.C. in these words:

"The coffee drinkers like to tell of filling a cup to the brim without losing a drop. . . . Smokers describe their long ash. There's a sensation of standing still with the world running past you."

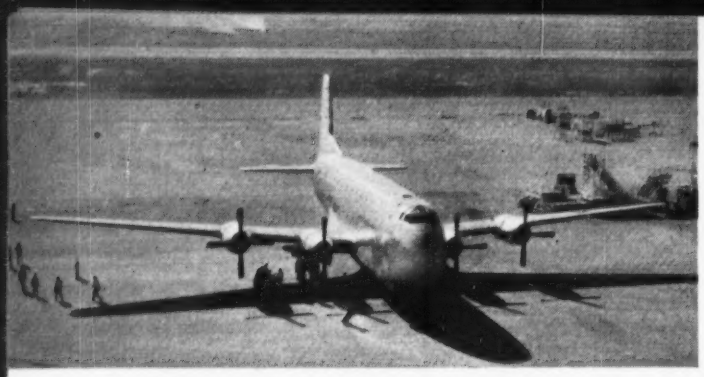




227 *(Top) Avro 707 (1949).*

228 *(Centre) Fouga Cyclone —later Sylphe—of 1949.*

229 *(Left) de Havilland Comet (1949).*



230 *Inter-continental troopship: the Douglas Globemaster II (1949).*

THE FIRST FIFTY YEARS . . .

(1949 Cont.) Although the Douglas Globemaster II (**230**) is not the world's largest military transport (that distinction belongs to Convair's C-99) it is a machine of great size and importance. Its size is best gauged by the figures for span and weight—173ft and 175,000 lb—and its importance by the fact that large numbers are in service with the U.S.A.F. A feature is an electrically operated lift in the cargo hold.

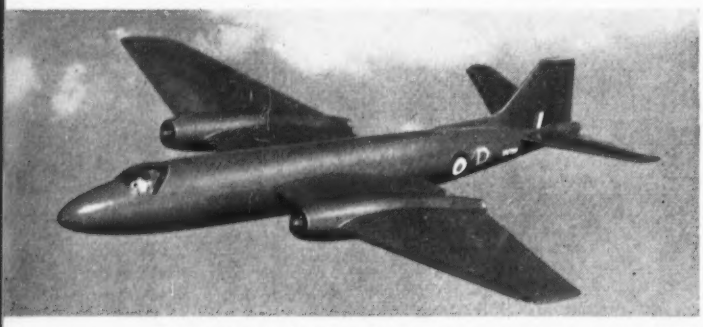
Having acknowledged the success of this great aircraft, it is sad to have to write off our own Bristol Brabazon (**232**) as an expensive experiment. It was, however, a very notable achievement, even in its Mk 1 (piston-engined) form. The Mk 2—the largely completed airframe of which has now been broken up, together with the first machine—was to have been powered with Coupled Proteus turboprops and to cruise at 330 m.p.h.

A resounding success from the outset was the English Electric Canberra (**231**), now a standard light bomber in four air forces and in quantity production in America as well as in five factories in the British Commonwealth. The Canberra is normally powered by two Rolls-Royce Avons and was the first jet aircraft to fly the Atlantic without refuelling. Fitted with two Bristol Olympus two-spool turbojets, a slightly modified example established a world altitude record of 63,668ft on May 4th this year and about six months later a photographic reconnaissance version was victorious in the England-New Zealand Race. Manned by an R.A.F. crew, it covered the 11,796 miles to Christchurch in 23 hr 51 min.

In past pages we have illustrated a number of aircraft with "mixed" power plants at **233** is one more. It is the Republic XF-91 intercepter which, in addition to its turbojet, has rockets. The wing has inverse taper and variable incidence.

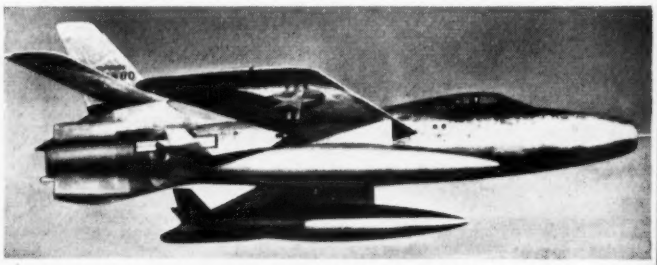
One distinction attaching to the Chase XC-123 military transport (**234**) is that the basic airframe has been flown as a glider, with piston engines and with jets. Of more practical interest is the machine's capacity (e.g., 60 fully equipped troops), combined with ease of loading (through rear doors), relatively low power (two 2,300 h.p. Double Wasps), and good speed range (75-245 m.p.h.). An aircraft which proved that rotary-wing machines, too, are invaluable for military transport was the Sikorsky S-55 (**235**). As the picture shows, a feature is the accessibility of the power plant—a special version of the famous Pratt and Whitney Wasp.

Grouped together (**236** and **237**) are two outstanding Naval turboprop machines—the Fairey G.R.17 from which the present-day Gannet was developed, and the Westland Wyvern. The Gannet is an anti-submarine aircraft and benefits greatly from its ability to cruise on one "half" of the Armstrong Siddeley Double Mamba turboprop, reserving full power for take-off, strike and emergency. Features of the Python-engined Wyvern strike aircraft visible in the picture are the contra-rotating eight-blade airscrew and Youngman flaps. Note torpedo and rockets.

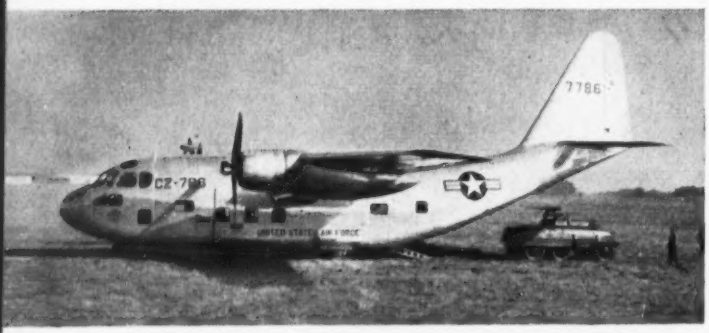


231 *Bomber load, fighter characteristics: Canberra prototype of 1949.*

232 *The Bristol Brabazon 1 (1949)—written off as "experience."*



233 *With turbojet and rockets: the Republic XF-91 (1949).*

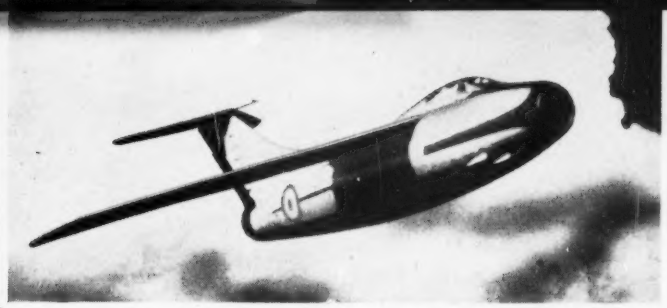


234 *Original thinking, manifest in the Chase XC-123 (1949).*

235 *The Sikorsky S-55 (1949) is greatly superior to the S-51.*

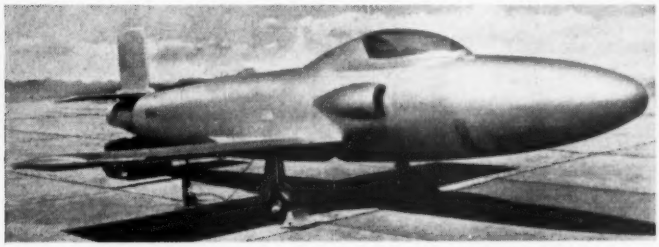
236 *An A.S. Double Mamba turboprop powered the Fairey G.R.17 (1949.)*

237 *Designed to strike: the Python-powered Westland Wyvern (1949).*

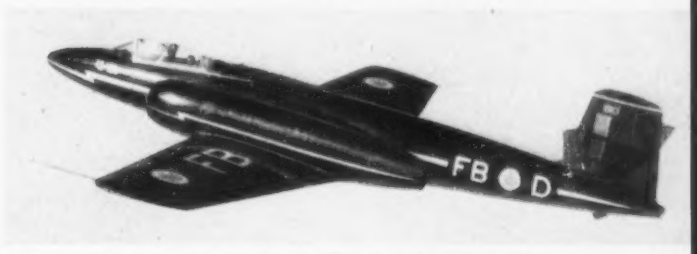


238 *The German-designed, British-powered Pulqui II, 1950.*

239 *The first turboprop flying-boat was the Convair XP5Y-1 of 1950.*



240 *Australia's Pika (1950) was a piloted prototype of a pilotless target.*



241 *Prototype of the Avro Canada CF-100 all-weather fighter, 1950.*

1950 Although the Germans had conducted a great deal of basic research into the properties of swept wings as a means of achieving higher speeds, prototypes which were to benefit were incomplete when the war ended. Professor Tank, of Focke-Wulf, was but one German technician who sought an early opportunity to emigrate, and under his direction the Nene-powered Pulqui II (**238**), of the Argentine Instituto Aerotecnico, was built. It is worth comparing with the Mig-15.

By 1950 America's turboprop programme was slowly advancing, and the first large flying-boat to use these power plants was the U.S. Navy's magnificent Convair XP5Y-1 (**239**). Four Allison T-40 "double" units, of a nominal 5,500 h.p. each, gave a top speed of about 390 m.p.h.

Two of the remaining types for 1950 are symptomatic of the increasing part played by the Commonwealth in aircraft development. The Pika (**240**) was a piloted prototype of the Jindivik pilotless target aircraft, which flew under automatic control in 1952. Both aircraft are products of the Division of Aircraft Production of the Australian Department of Supply. The Avro Canada CF-100 (**241**), first flown with Rolls-Royce Avons, is a twin-jet all-weather fighter, designed with an eye to the climatic and geographic problems peculiar to Canada. A Mk 4 prototype, powered (like all production models) with Avro-Canada Orendas, achieved supersonic speed in the dive last year.

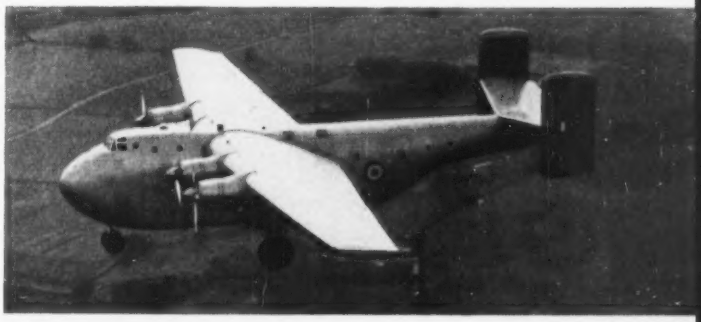
The massive freighter at **242** is the Blackburn and General Aircraft G.A.L.60, the Hercules-powered prototype of the larger, heavier, Centaurus-engined Beverley now in production.

The designed task of the G.A.L.60 was the transport of heavy military equipment, stores and personnel, to be landed on secondary airfields or dropped by parachute through the rear doorway. At the opposite end of the freighter scale is the unique Auster Ambulance/Freighter (**245**), produced by a British company long famed for its A.O.P., touring and training monoplanes.

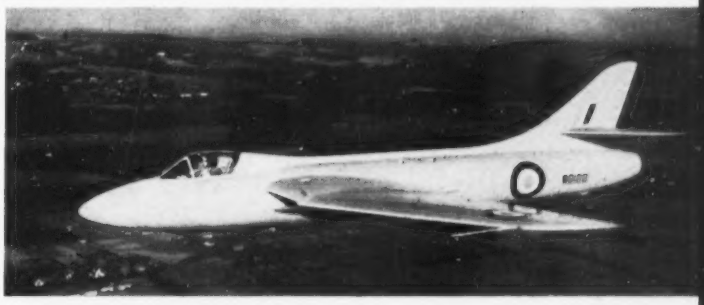
1951 One of the most beautiful aircraft ever built, the Hawker P.1067 (**243**) now in production as the Hunter, was designed round a Rolls-Royce Avon turbojet and an armament of four 30mm guns. It has a counterpart in the Supermarine Swift, which was developed from the straight-wing E.10/44 as was the Hunter from the P.1040. On September 7th, 1953 an Avon-powered Hunter (some production aircraft have the Armstrong Siddeley Sapphire) set up a world speed record of 727.6 m.p.h. This was soon surpassed by a Swift, which took advantage of the heat of North Africa in achieving 737.3 m.p.h.

The Italian Fiat, Macchi, Piaggio and Ambrosini concerns have been noted for many years for their attractive and serviceable training aircraft. At **244** we show Italy's first jet trainer, the beautifully constructed G.80, powered with a de Havilland Goblin turbojet and capable of 550 m.p.h.

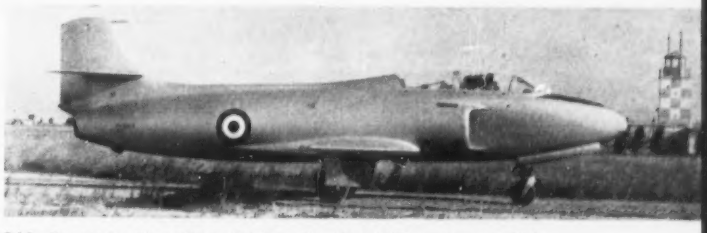
The Scottish Aviation Prestwick Pioneer Mk 2 (**246**) is an excellent modern example of the high-lift, high-wing monoplane formula popularized by the Fieseler Storch. A five-seater, it takes off in 75 yd and lands in 66 yd.



242 *Blackburn and General Aircraft G.A.L. 60, of 1950.*



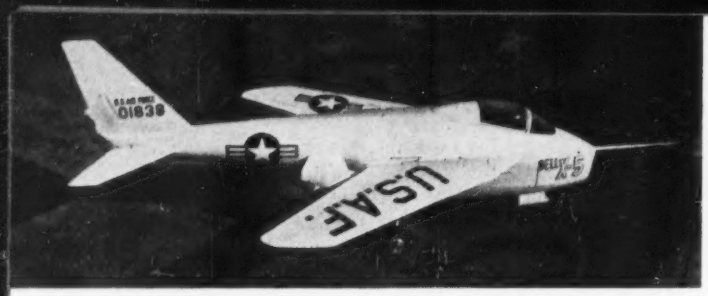
243 *This first prototype of the Hawker Hunter flew in 1951.*



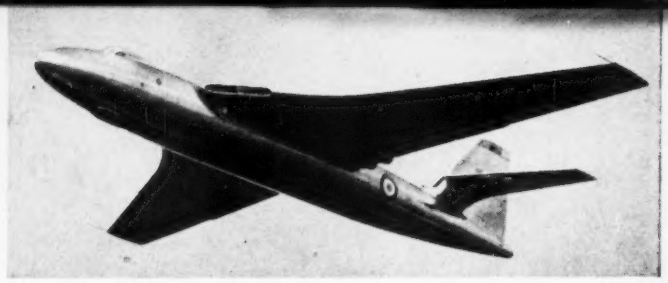
244 *Powered with a D.H. Goblin : the Fiat G.80 trainer of 1951.*

245 *Auster Ambulance/Freighter of 1951, with Cirrus Bombardier.*

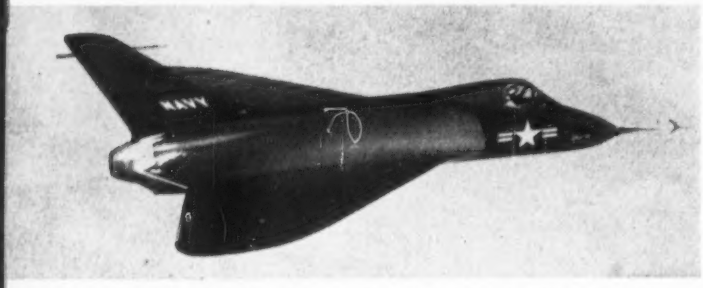
246 *The Scottish Aviation Prestwick Pioneer Mk 2 (1951).*



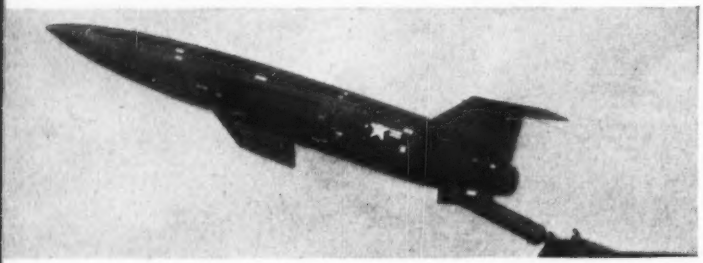
246 *The variable-sweep Bell X-5 research aircraft, flown in 1951.*



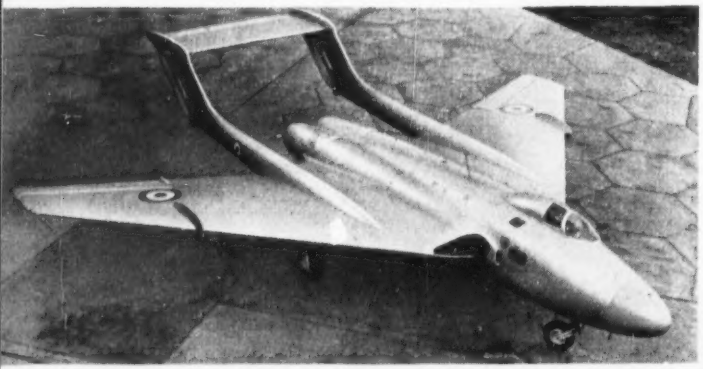
247 *The R.A.F.'s first four-jet bomber—the Vickers Valiant B.1, 1951.*



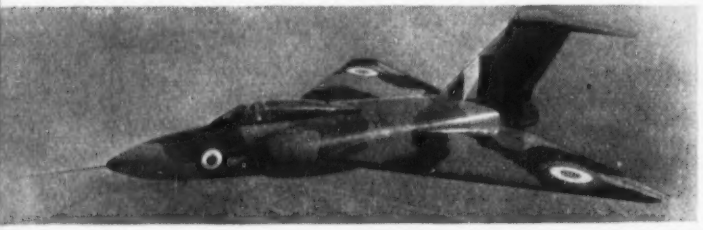
248 *A version of this Douglas Skyray (1951) holds the speed record.*



249 *First U.S.A.F. pilotless bomber was the Martin Matador, 1951.*



250 *The world's first supersonic multi-seater was the D.H.110 of 1951.*



251 *Fast-climbing and manoeuvrable—the Gloster Javelin (1951).*

THE FIRST FIFTY YEARS . . .

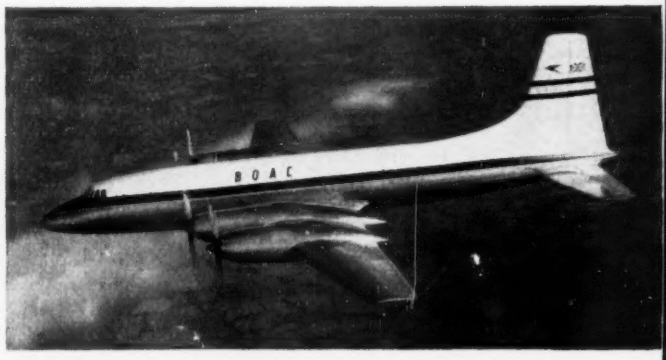
(1951 Cont.) A research project of uncommon interest, sponsored by the U.S.A.F., the N.A.C.A. and the Bell company, is the X-5 (**246**), built to investigate the aerodynamic effects of changing the degree of wing sweepback in flight (simultaneously, of course, compensating for the resulting shift of c.g.). No less striking in appearance, although it is the prototype of a standard naval fighter, is the Douglas Skyray (**248**). This design goes back to 1945, when reports and studies of Professor Lippisch, the German delta pioneer, came into the hands of a U.S. intelligence team. On October 3rd, 1953, the second Skyray prototype established the present world speed record of 753.4 m.p.h. and more recently underwent carrier trials.

A contemporary of the Skyray, in the bomber category (and no less notable in concept) is the Vickers Valiant B.1 (**247**), featuring a moderately swept wing having roots of sufficient chord and depth to contain four Rolls-Royce Avons. The Valiant is the R.A.F.'s first four-jet bomber. A Mk 2 "pathfinder" version, believed to be stressed for very high speeds at low level, lately made its appearance. Though given a normal bomber designation (B-61) the U.S.A.F.'s Martin Matador (**249**) is pilotless. Turbojet-propelled and rocket-launched, it is vastly more effective (and more expensive) than the war-time V-1.

The massive fighters at **250** and **251** are the D.H.110 and Gloster Javelin, designed to a specification calling for extremely high performance, heavy armament and elaborate radar search and navigation aids. The first fighter of its class to achieve supersonic speed in a dive, the D.H.110 is powered with two Rolls-Royce Avons and at the time of writing is under development for the Royal Navy. The delta-wing Javelin is Sapphire-powered and by virtue of its low wing loading is uncommonly tractable at the lower end of the speed range. The maker's chief test pilot avers that its characteristics "vary but little from those of any conventional old-type plank-wing aircraft."

1952 The majestic machines at **252** and **253** are pre-eminent examples of turboprop airliners. Three of the 150-ton Saunders-Roe Princesses have been built, though two have been "embalmed" and the whole project is still in the balance at the present time. The ten Proteus turboprops are mounted as four coupled pairs and two single units outboard; span is 219ft 6in, fuel capacity 14,500 gal and gross weight 315,000 lb.

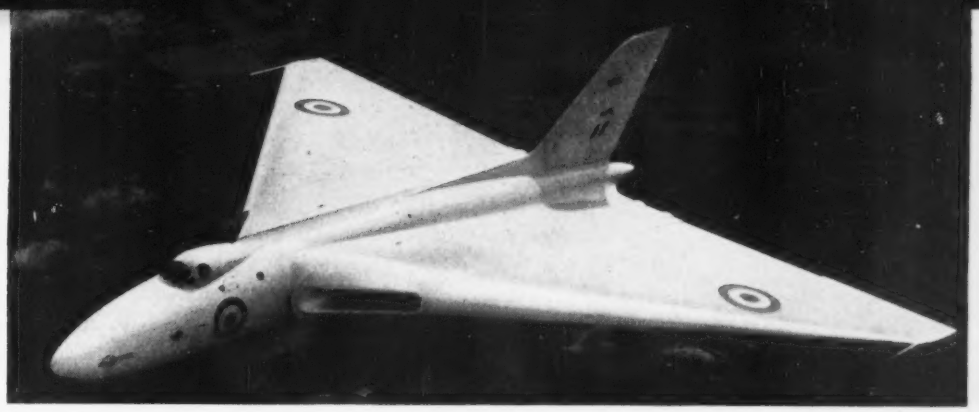
Bristol's Britannia has four single Proteus units, the economy of which, combined with the lowest specific structure-weight yet achieved in a transport aircraft, confer outstanding flexibility of load and range.



252 *Quiet, graceful, economical—the Bristol Britannia, 1952.*

253 *A masterpiece of British aeronautical engineering is the Saunders-Roe Princess double-deck, 150-ton flying-boat, first flown in 1952.*

784-785
FLIGHT, 11 *December* 1953

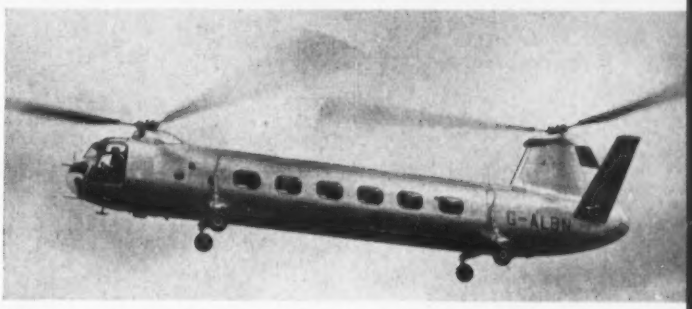


254 *Latest member of the Avro family, which has included such historic machines as the Type 504 and Lancaster, is the Vulcan delta-wing bomber, first flown in 1952.*

A dream come true was the Avro Vulcan bomber of 1952, for it was the splendid realization of the long-cherished "paper dart" ideal. The extreme cleanness of outline afforded by the delta configuration is admirably shown in the picture at **254**—a picture which even to the layman is strongly suggestive of speed combined with load-carrying capacity.

It is not often that a Minister of State refers to a new aircraft in such terms as these, used by the Minister of Supply on the occasion of the Vulcan's first flight:

"The advent of this huge four-jet delta plane represents yet another dramatic leap in the progress of British aviation and may well have a profound influence upon future development, not only in air warfare but also in civil transport. The bold decision to adopt the triangular wing for an aircraft of this size and to dispense with the tailplane was an act of faith for which the designers and manufacturers deserve the highest praise."



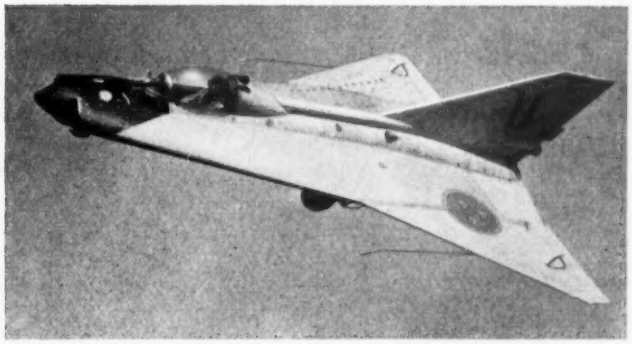
255 *The helicopter airliner realized: Bristol's 173 Mk 1 (1952).*

A palpable advance in helicopter design was the Bristol 173 Mk 1, shown at **255**. A departure of particular interest is the use of two engines (Alvis Leonides) with a synchronizing shaft between them, which ensures that both engines turn at the same speed and enables one to drive both rotors if the other fails. Earlier this year a 173 was fitted experimentally with wings—a feature which will be incorporated in later machines with a view to "unloading" the rotors and raising the cruising speed.

Two of the world's smallest jet aircraft are the Swedish Saab Draken "double delta" research machine (**256**) and the French Sipa 200 Minijet (**259**). The Palas turbojet of the Minijet needs only 22 gallons of kerosine per hour.

Resembling each other in layout are France's land-based S.O.4050 Vautour (**257**) and the carrier-borne Douglas A3D (**258**). The A3D is the most formidable attack machine yet developed for naval use, and carries atomic, or other, weapons in great variety.

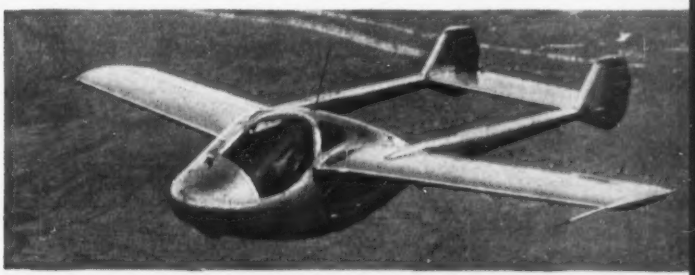
At the foot of the page are two machines which made their debut at the 1953 S.B.A.C. Display: the Handley Page Victor four-jet bomber (**260**) and the Short S.B.5 research aircraft (**261**). The key feature of the magnificent Victor is the "crescent" wing, the relatively thick, sharply swept, inboard sections of which house the four Armstrong Siddeley Sapphire turbojets. Immediately outboard are thinner, less swept portions, and the outermost panels are very thin indeed, with even less sweep. The S.B.5 was built for research into the low-speed qualities of sharply swept wings.



256 *Sweden looks ahead: the Saab Draken research aircraft (1952).*

257 *Among France's post-war best: the S.O.4050 Vautour (1952).*

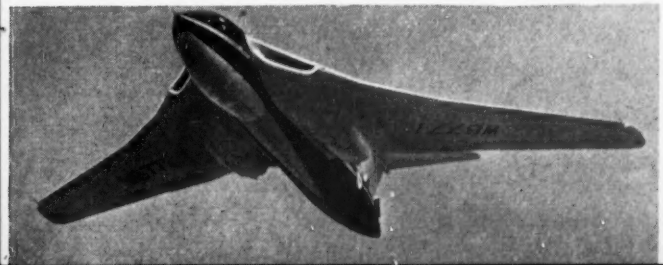
253 *Seaborne air power, epitomized by the Douglas A3D (1952).*

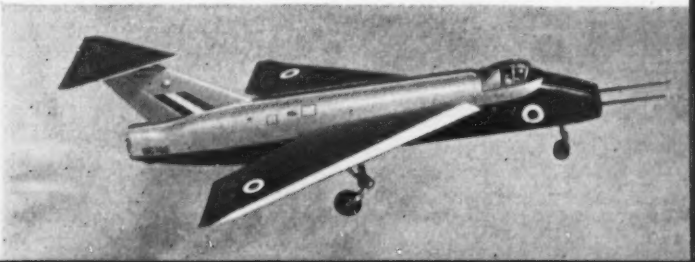


259 *Jet runabout: the Sipa 200 Minijet (1952).*

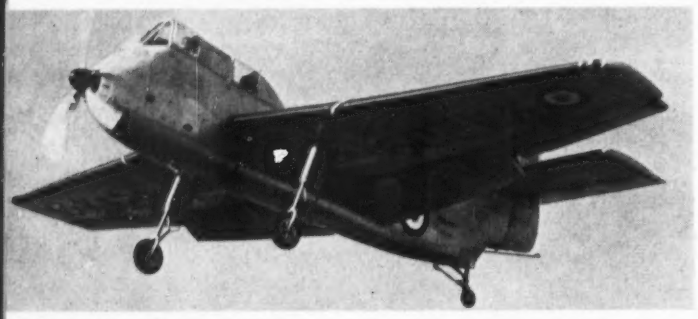
260 *The crescent-wing Handley Page Victor (1952.)*

261 *Low-speed research for high-speed flight: Short S.B.5.*

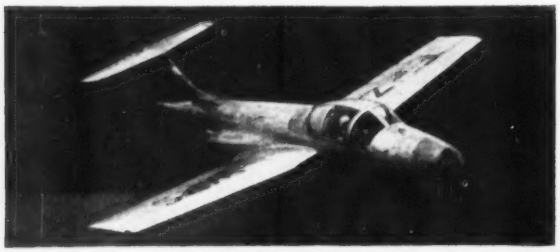




262 *The world's largest helicopter is Piasecki's YH-16.*



264 *Back to simplicity—the anti-submarine Short Seamew.*



265 *By a famous French constructor: the Morane Fleuret trainer (1953)*

THE FIRST FIFTY YEARS . . .

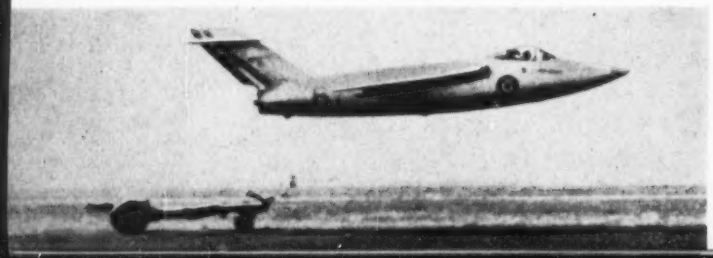
1953 This is the last page of a history; yet it is ahead of the news, for mostly the machines are unproven.

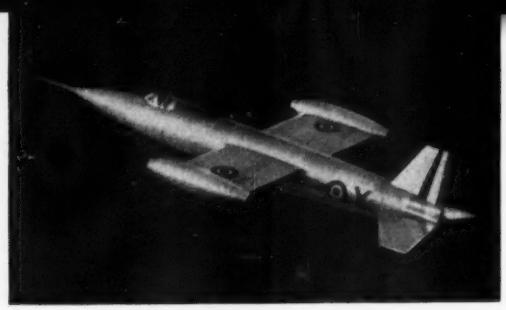
First is the Piasecki YH-16 (**262**), the world's largest helicopter, weighing 35,000 lb and capable of carrying 40 troops. Then comes the S.O. 9000 Trident (**263**), built to provide data for a supersonic intercepter and having a rocket motor in the tail and Turboméca turbojets at the wing tips.

Above (**264**) is the Short Seamew anti-submarine aircraft, a sturdy, inexpensive type designed to operate from the smaller aircraft carriers. Below it, at **265**, is the Morane Fleuret light jet trainer, with twin Turbomécas and side-by-side seating, followed at **266** by the Short Sherpa research aircraft, which has an "isoclinic" wing. The principle is that, instead of being as stiff as possible, the wing is relatively flexible and distorts, as the makers put it, "in an advantageous manner." The North

268 *Delta-wing and hydro-skis: the Convair Sea Dart.*

270 *Trolley take-off, skid landing: the Baroudeur.*





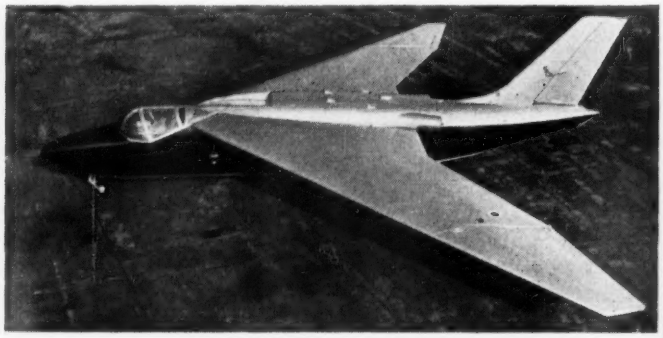
263 *Tail-mounted rocket, tip-mounted turbojets: the Trident.*

American YF-100, at **267**, is a very remarkable fighter indeed, as witness its achievement of supersonic speed on its maiden trip.

A U.S. Navy fighter of altogether exceptional interest is the Convair Sea Dart (**268**). This is a delta-wing machine which, when at rest, is partially submerged in the water, and which rises into the air, and descends again, through the medium of "hydro-skis."

Remarkable French designs are the Hurel Dubois HD-31 transport (**269**), with its wing of 20.2:1 aspect ratio, and the S.E. 5000 Baroudeur, at **270**, a rocket-launched fighter/attack aircraft which takes off from a trolley and lands on skids.

Last, at **271**, is the Douglas X-3 research aircraft designed—when the power is available—for a Mach number of 3 (representing 1,960-2,280 m.p.h., depending on height) and altitudes of the order of 200,000-300,000ft. Speculating on how this "phenomenal" machine will appear to readers half a century hence, we leave the great company of aircraft which have had their exits and their entrances during the *first* fifty years.

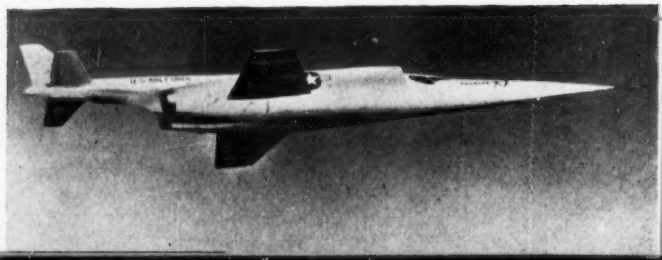


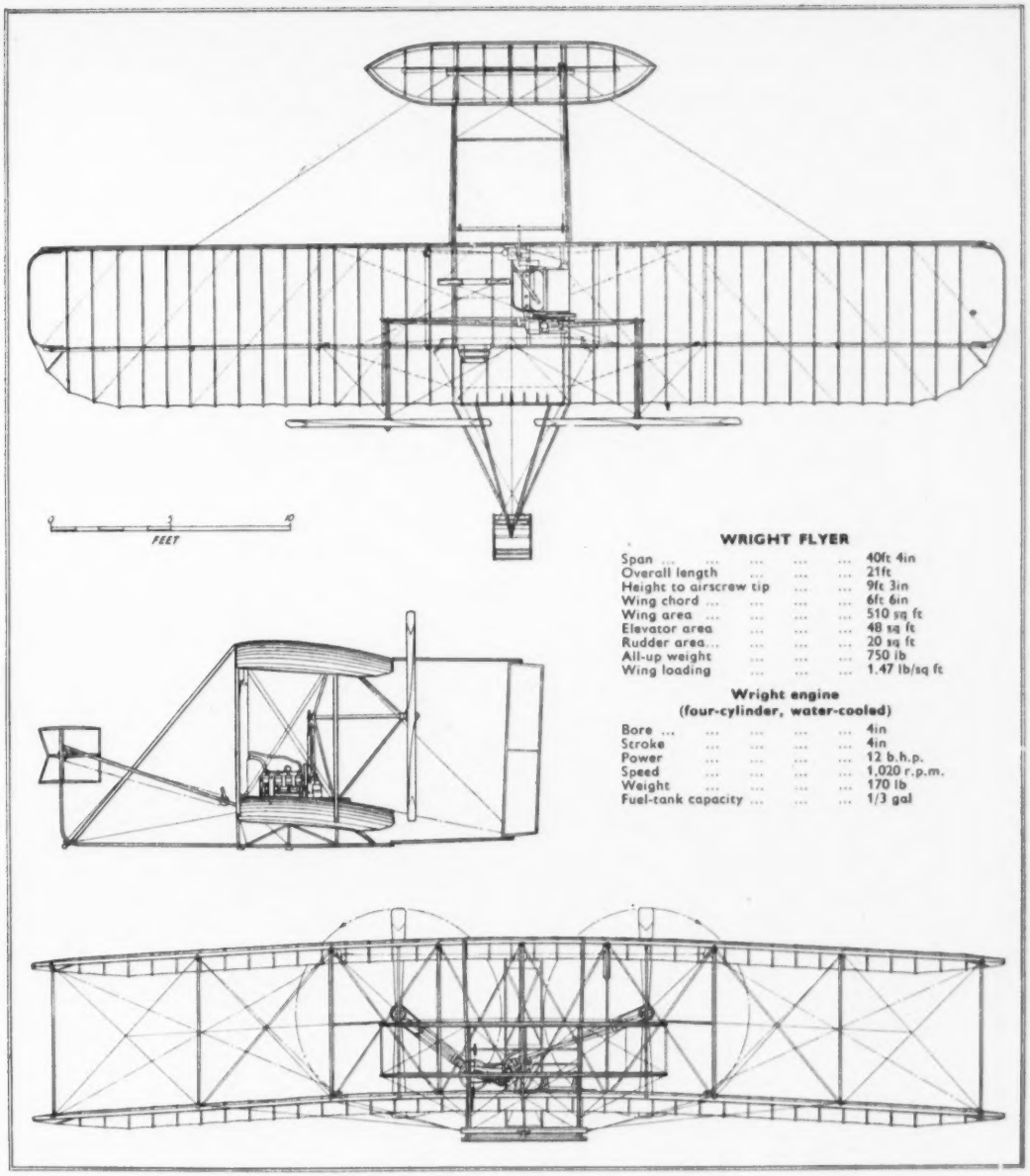
266 *The Short Sherpa research aircraft, with isoclinic wing.*

267 *Supersonic speed on the level: North American YF-100.*

269 *Seeking low induced drag: the Hurel Dubois HD-31.*

271 *Designed for Mach 3: the Douglas X-3.*




0 5 10
FEET
WRIGHT FLYER
Span 40ft 4in
Overall length 21ft
Height to airscrew tip 9ft 3in
Wing chord 6ft 6in
Wing area ... ... 510 sq ft
Elevator area ... ... 48 sq ft
Rudder area... ... ... 20 sq ft
All-up weight ... ... 750 lb
Wing loading ... ... 1.47 lb/sq ft
Wright engine
(four-cylinder, water-cooled)
Bore 4in
Stroke 4in
Power ... ... 12 b.h.p.
Speed ... ... 1,020 r.p.m.
Weight ... ... 170 lb
Fuel-tank capacity ... ... 1/3 gal

In this three-view G.A. drawing of the Wright brothers' first powered aircraft, the upper wing is omitted, for clarity, in the plan view. Flying-control wires are shown chain-dotted, bracing wires as solid lines, and stitch-lines on the fabric hatched.

"FLIGHT" Copyright Drawing

THE WRIGHT FLYER

"The objects of our invention are, first, to provide a structure combining lightness, strength, convenience of construction and the least possible edge resistance; second, to provide means for maintaining or restoring the equilibrium of the apparatus; and third, to provide efficient means of guiding the machine in both vertical and horizontal directions. We obtain these objects by the mechanism shown in the accompanying drawing."

THESE words form the introduction to an early patent specification by the Wright brothers, and the drawing showed an aircraft very similar in design to the historic "Flyer" above, though without an engine. It was with their gliders of 1900 to 1902 that the Wright brothers laid reliable foundations for the powered Flyer, and in particular solved the serious problem of effective control.

The immediate predecessor to the Flyer was the Wrights' third glider, based both on experience with their two earlier machines and on the test work performed on over 200 model wing-sections in their 16in-square wind tunnel. The third machine was originally fitted with a tail unit comprising two fixed vertical fins on outriggers (the previous gliders had had no tail), and rolling motion was controlled by warping the wings in opposite directions.

Only one main control-problem arose: due to the difference in drag between port and starboard wings when warped in opposite directions in a bank, the aircraft tended to turn "against" the bank, i.e. towards the raised wing. The Wrights' solution to this problem, which in large measure was responsible for the relatively good controllability of their powered machine, was to replace the twin fixed fins by a movable rudder and to link the rudder control with the wing-warping wires. This they described in their patent filed soon afterwards:

"The same motion of the ropes which actuates the wing tips also presents to the wind that side of the vertical rear-rudder which is toward the tip having the smaller angle of incidence. The wing tip presented to the wind at the greater angle, under the usual conditions of flight, has both greater lift and greater drift, or resistance, than the other. The wing with the greater angle, therefore, tends to rise and drop behind, while the other sinks and moves ahead. Under these circumstances the longitudinal axis of the machine tends to turn toward the wing having the greater angle, while the general course of the machine through the air tends toward the wing which is lowest, with the result that a wide divergence soon arises between the direction which the machine faces and its actual direction of travel. By the use of a rear movable vertical rudder, so operated as to present to the wind that side which is toward the wing having the least angle, we obtain a turning force opposite to and greater than that arising from the difference in the resistance of the two wings, and thus are able to keep the longitudinal axis of the machine approximately in coincidence with the line of flight."

Well satisfied with the performance and control of the glider (which made nearly a thousand flights) the Wright brothers began serious work on the design and construction of their powered

THE WRIGHT FLYER . . .

machine towards the end of 1902. Having failed to find a car manufacturer able to supply a suitable engine—as related in another article in this issue—they designed and built their own, a horizontal four-cylinder water-cooled unit. Construction of the airframe began in June 1903 and was completed by September.

As on the Wrights' gliders, "the superposed horizontal surfaces formed by stretching cloth upon frames of wood and wire constitute the 'wings' or supporting parts of the apparatus. They are connected to each other through hinge-joints by upright standards and lateral stay-wires which, together with the lateral spars of the wing framing, form truss systems, giving the whole machine great transverse rigidity and strength." To accommodate the wing warping, however, "the hinge-joints admit of both flexing and twisting movements."

Spruce and ash are widely used in the construction of the biplane. (We write in the present tense deliberately, for the machine still exists.) On the mainplanes, spruce is used for the ribs and tips, and ash for the main spar, leading edge, and the short central trailing edge which supports the upper rudder struts. The main spars are in three lengths, each of 1 11/16in × 1¼in cross-section (and slotted to depths of 5/16in to take the top and bottom capping of each rib) with a simple metal band slipped over the joints. From a consideration of these joints and the reduction in section due to the rib slots, the wing droop found on the machine comes as no surprise. The radius of this "anhedral arc" was measured as 244ft.

The leading edge takes the place of the normal front spar and is constructed of 1¼in × 1¼in ash, rounded on the front face. The inter-plane struts, made of spruce, are of 1 15/16in × ¾in section at the centre, tapering to 1¼in × ¾in at the ends, and have rounded corners. Their extremities carry ¼in wire eyes which engage with clips on the main spar and the leading edge. The trailing edge of the wing is of piano wire pocketed into the fold of fabric ("Pride of the West" muslin) and attached to the ribs by tape. An interesting fact is that the semi-span, measured from the central strut, is 19ft 11 15/16in to port and 20ft 4 1/16in to starboard. It is not known whether this was intentional or an indication of the manufacturing tolerances of 1903!

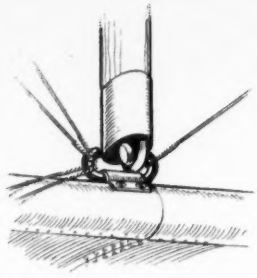
The brothers Wright had produced sound reasoning to justify their choice of elevator configuration for their earlier gliders: "contrary to the usual custom, we place the horizontal rudder in front of the main surfaces or wings at a negative angle, and use no horizontal tail at all. By this arrangement, we obtain a forward surface which is almost free from pressure under ordinary conditions of flight, but which, even if not moved at all, becomes an efficient lifting surface whenever the speed of the machine is accidentally reduced very much below the normal, and thus largely counteracts that backward travel of the centre of pressure on the main surfaces or wings, which has frequently been productive of serious injuries by causing the machine to turn downward and strike the ground head-on."

The same configuration, though with twin surfaces, and without the negative angle of attack, was retained for the Flyer. Construction of the elevators was of spruce, again with "Pride of the West" muslin as a covering for the flying surfaces. Movement of the elevator is achieved by a control frame comprising a ⅜in-diameter steel tube with three control ribs and a spruce pulley wheel rigidly attached, and pivoting about two U-clips screwed to the vertical elevator bearers. The ribs of this frame are connected by pin-jointed struts at their leading and trailing edges to the actual elevator surfaces, which pivot on clips attached to the vertical bearers. A further three pin-jointed struts at the tips and centre connect the two elevator spars.

Wires and chandelier chains passing over the spruce pulley connect the control frame directly with the pulley at the end of the pilot's horizontal control bar (which has a vertical hand-lever at the opposite end). Thus rotational movement of the bar caused by movement of the lever is transferred to the elevator.

The rudder installation consists of two covered surfaces forming opposite sides of a rectangular box framework, which is pivoted top and bottom on its central axis at the extremities of two horizontal Vee spruce frames. The inboard ends of these frames are hooked on to the trailing edge of the upper wing and the main fuselage frame.

Spruce and ash are again used for the members of this frame, which runs forward beneath the wings to end at the upswept elevator supports. Transverse skids are fitted across the frame, and spruce struts connect the upper plane with the bottom of the elevator supports, and the lower plane with the elevator supports at a position just above the control frame. Between the latter pair of struts, just ahead of the wing leading edge, the pilot's elevator control bar is mounted.



The lower end of one of the vertical struts, showing its attachment to the leading edge.

Linkages in the piano-wire control runs consist of short sections of chain passing over pulleys. As mentioned, wing warping was used in place of ailerons, and was combined with the movement of the rudder. To move the rudder and wing controls, the pilot twisted his body sideways, so moving the wooden cradle in which he lay. (The pilot's position is prone, to the left of the engine and on the central portion of the lower mainplane: the prone position was chosen simply to reduce air resistance.)

From the upper wing surface, wires pass from the top of the outboard rear strut (and from the top of the second rear strut) diagonally to the bottom of the third strut, along the lower wing to the corresponding strut on the opposite side, and diagonally up to the outboard (and second) strut at the other end of the wing. These wires are linked to the pilot's cradle and another wire leads from the lower end of the outboard strut to the top of the third strut, and along and diagonally down again in symmetrical manner. The central portion of the lower wing-surface control-wire passes between two bell-cranks, to which are attached also the rudder-control wires; these pass to the bottom inter-rudder strut, crossing over shortly before attachment.

The Wright engine weighed 170 lb* and developed 12 b.h.p. at 1,020 r.p.m. (16 b.h.p. at 1,200 r.p.m. was obtained for the first few seconds after starting). It had automatic inlet valves, direct fuel injection, and magneto ignition. From the engine, the drive to the shafts of the two pusher airscrews was by chains (the port one crossed to provide counter-rotation), which passed through mild-steel guide tubes. A low-tension generator was incorporated.

The airscrews were of spruce, carved from the solid, and had fabric-covered tips. Their design and construction followed much painstaking research work by the Wrights on model airscrews in addition to their previous work on aerofoils. Shortly after the biplane had been completed, the tubular airscrew shafts then fitted fractured during engine-testing and were replaced by solid shafts. The outer tube in which each shaft runs is braced in position between the upper and lower planes in a simple system of metal bearer-tubes and by two bracing wires. Airscrew thrust efficiency was stated to be 66 per cent.

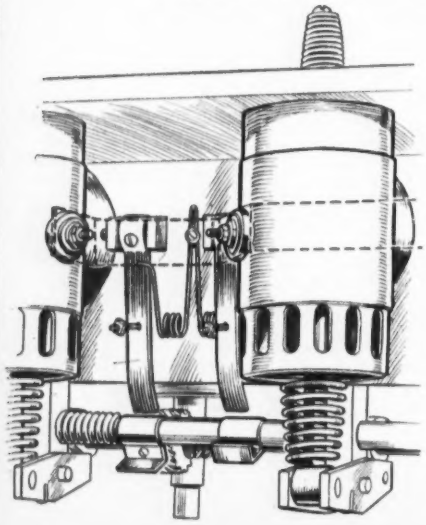
Instrumentation was simple yet ingenious, consisting of an anemometer, stopwatch and rev *counter* (not tachometer), mounted on the forward central strut. Flight duration and anemometer revs were automatically recorded, enabling the air speed to be calculated.

The absence of a fixed vertical fin, a fixed horizontal tail and of wing dihedral made the 1903 Wright Flyer an aircraft with no automatic or "built-in" stability; the pilot had to control the machine manually and continuously during flight, and this was in accord with the brothers' original design intentions.

From 1928 until 1948 the actual Wright Flyer formed a part of the National Aeronautical Collection at the Science Museum, South Kensington, London. Prior to its return to the U.S.A. in 1948, an exact replica of the biplane was constructed by the apprentices of the de Havilland Technical School, for the Museum.

Much help in the preparation of this description of the Flyer has come both from the de Havilland Company (Mr. H. D. Wright and Mr. W. Honeywood of the Technical School) and from the staff of the Science Museum, whose drawings of the original machine have contributed much to the detail and accuracy of our own specially prepared three-view G.A. on the previous page.

To those who have found this brief description of interest, we would suggest a visit to South Kensington, to view there the excellent Wright biplane replica. Only by seeing the shape and form of this machine "in the flesh" can its interesting design and ingenious control system be fully appreciated. But more important than its technical interest is, of course, its place in history. For this is the machine that *made* history, just fifty years ago at Kitty Hawk.



Ignition of the Wright engine. The secondary shaft shown carries cams which operate the low-tension make-and-break mechanisms inside the cylinder heads. Contact between the points is first made as the cams press the spring levers against the spring-loaded stop; the quick break which initiates a spark between the points is caused by the spring levers slipping off the end of the cams. The copper strip connecting the plugs is shown dotted.

**Some authorities have quoted other weights for this engine, e.g., 180 and 240 lb; but we believe 170 lb (including magneto and flywheel) to be a reliable figure.*

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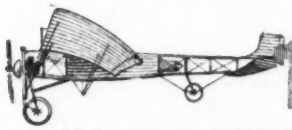


1909

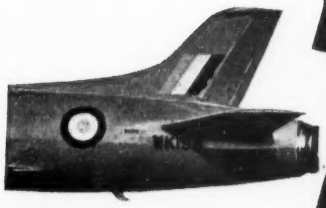
The first flight across the English Channel was made by Louis Blériot.

1919

First non-stop Transatlantic Flight, West to East, Sir John Alcock, Sir Arthur W. Brown.

1928

First solo flight — England to Australia, Squadron Leader Bert Hinkler.



1953

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THE ROYAL TOUR OF THE WORLD

Twenty Thousand Miles by Air: The Queen Demonstrates Her Faith in Air Transport

Departure: The Queen and the Duke of Edinburgh board the Stratocruiser "Canopus" at London Airport on the evening of November 23rd.

FOR the first time in history a reigning monarch of Great Britain is travelling round the world to visit the Dominions and Colonies. During the tour on which Queen Elizabeth II has embarked, with the Duke of Edinburgh, she will cover a total distance of 50,000 miles, will touch all seven continents of the world, and will be seen for the first time by her subjects in the South Seas, New Zealand, Australia and Ceylon. In New Zealand and Australia, particularly, her tour will include a large number of scattered and remote communities which, but for extensive use of air transport, time would not allow her to visit.

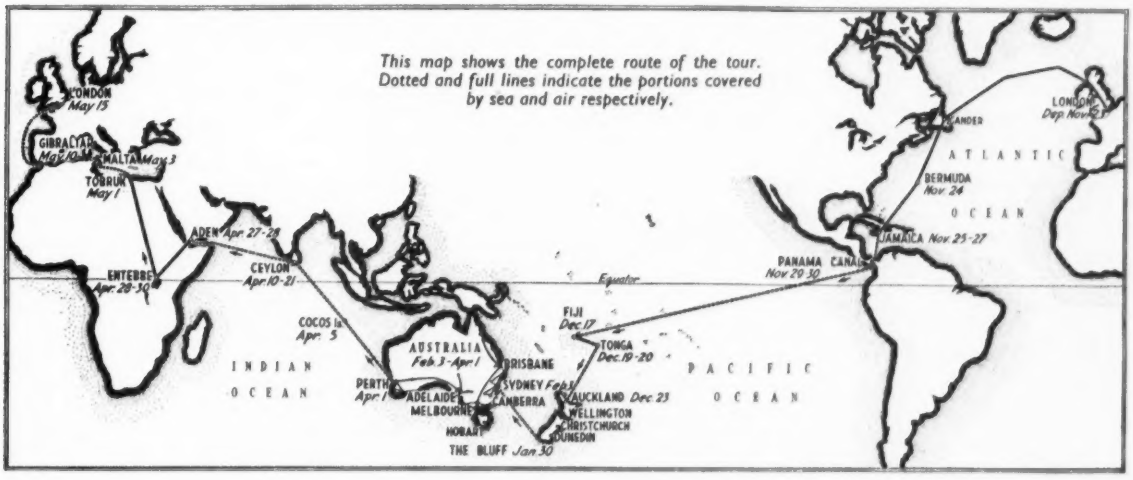
It was at Her Majesty's own request that arrangements were made for her to fly no less than 10,000 miles in Australia alone. Having already flown over 4,000 miles across the Atlantic (again as the first reigning monarch to do so) she is now aboard the liner *Gothic* approaching Fiji, whence she will fly to Tonga. After her visit to New Zealand and Australia, she will travel by sea *via* Ceylon to Aden, and there she will once more board an aircraft. She will fly from Aden to Entebbe and thence to Tobruk, covering in two days of travel a distance equivalent to almost the whole length of the African continent.

It can be said that without the use of air transport so extensive and thorough a tour would not have been possible, and that many of Her Majesty's subjects would have been deprived of this unique opportunity of seeing the monarch to whom they owe allegiance. But the Queen is no newcomer to air travel. Both she and the Duke of Edinburgh have, on numerous occasions, made use of the Vikings of the King's Flight, and have also undertaken together some notable long-distance air journeys. Before her accession to the throne they flew to Canada from England at the start of their Canadian tour in 1951. The aircraft on that occasion was the same Stratocruiser, *Canopus*, which carried them to Jamaica on November 23rd-25th. They also flew to Kenya, in 1952, at the beginning of the Australian tour which was so sadly interrupted by the death of the late King. The aircraft then was an Argonaut of B.O.A.C. The Queen has also shown a keen interest in air travel and a knowledge of air matters which has surprised the experts. She is at present patron of the Guild of Air Pilots and Air Navigators, and was previously Grand Master of the Guild. The present Grand Master is the Duke of Edinburgh. He is, of course, a qualified Service pilot and frequently flies his own D.H. Devon.

Yet travel by aeroplane, and all that it has come to imply in the modern world, is but fifty years old. Within living memory powered flight was a mere dream, and a challenge to the courage and ingenuity of the individual pioneer. Air transport as we know it today was not even seriously contemplated. In so short a span of time aircraft have been developed weighing sixty tons or more and equalling in size the craft which carried the sailors of the first Elizabethan age over to the New World. And these aircraft—both British and American types are concerned—have attained a standard of reliability and safety such that the Queen had no hesitation in deciding to make use of them for normal travel.

It is proposed in these pages to describe the arrangements made for air travel during the royal tour—to indicate graphically the significance of air transport in the Queen's journey and to demonstrate the advantage that travel by this means confers both on Her Majesty and, directly and indirectly, on her subjects.

Fiji, Tonga and New Zealand.—Next Thursday, December 17th, the Queen and the Duke of Edinburgh will arrive at Suva, in Fiji, aboard the liner *Gothic*. There they will receive the traditional welcomes of the island and open the new Central Medical School and inspect the Adi Cakobau School. On the following day they will be formally welcomed in the Colony's Legislative Council Chamber. During the morning, they will drive to the R.N.Z.A.F. flying-boat station at Laucala Bay, and there board a Solent of Tasman Empire



THE ROYAL TOUR OF THE WORLD . . .

Airways. This is one of the very few companies left in the world which still operates flying-boats on scheduled passenger services. The Solent will take the royal couple from Laucala Bay past the southern coast of Vitilevu to land at Lautoka, where they will go ashore at the Colonial Sugar Refining Company's wharf. After a series of official engagements on this side of the island, they will return in the Solent to Laucala Bay on the same day.

At nine a.m. on December 19th, after a 21-gun royal salute by a shore battery of the Fiji Artillery, Her Majesty will take-off in the Solent for the three-hour flight to Nukualofa in Tonga. Here she and the Duke of Edinburgh will be entertained by Queen Salote and members of her Government. They will watch Tongan dancing and attend a service in the Wesleyan church. Their visit will last altogether just over 24 hours, and they will leave Tonga in *Gothic* on December 20th bound for New Zealand.

Three days later, on December 23rd, *Gothic* will dock at Auckland, and the tour of New Zealand will begin. They will remain in the dominion until January 30th, visiting many of the towns both on the North and South Islands. They will travel through the length and breadth of New Zealand, making many of the more difficult and lengthy journeys by air. From Rotorua to Gisborne, they will travel in a Heron of National Airways Corporation. The aircraft, which will be modified as a ten-seater, and piloted by the Corporation's operations manager, Capt. H. C. Walker, is being used for this flight because Rotorua Airport is too small to accommodate a Dakota in certain weather conditions.

On all the other six flights that the Queen will make in New Zealand, the aircraft will be a specially modified Dakota from No. 42 Squadron, R.N.Z.A.F. As announced in *Flight* of August 21st, the R.N.Z.A.F. has formed a Queen's Flight at Ohakea, near Wellington. This unit is well advanced in its training and the royal aircraft itself has been prepared with great care: new engines have been installed, and every type of radio equipment and navigational aid used in New Zealand has been added. Furnishing materials are either non-inflammable or flameproofed. The Dakota will carry eight passengers, and other aircraft, including a Dakota, a Devon and a Bristol Freighter, will carry the royal retinue and the necessary servicing personnel for the Flight.

On landing at Gisborne on January 6th, the Queen will board the royal Dakota and fly to Napier. Three days later, having crossed North Island, she will fly from New Plymouth to Wellington. From Wellington she will make many visits in the surrounding area, both by train and car, and will finally leave by air from Wellington's Paraparaumu Airport on January 16th. She will fly to Blenheim and thence on the same day to Tahunanui Airport, Nelson. After a night stop at Nelson, Her Majesty will fly to Kavatiri Airport, Westport, and, after a public welcome there, will continue to Hokitika, on the west coast of South Island.

From Hokitika the Queen and the Duke of Edinburgh will travel by rail and road to the southern tip of South Island. They will visit Christchurch on the east coast and Dunedin, and depart in *Gothic* from Bluff on Saturday, January 30th. The liner will then carry them to Sydney, where they will begin their tour of Australia.

Australia.—As the ship approaches Sydney on February 3rd she will be met by an escort of R.A.A.F. Vampires and

New Zealand: The heavy lines show the routes of the royal party's flights during their visit to the Dominion.

Mustangs. In a statement made during November, the Minister in charge of the Royal Visit, the Rt. Hon. Eric J. Harrison, M.P., said:

"Her Majesty the Queen and H.R.H. the Duke of Edinburgh will visit nearly fifty country centres, in addition to capital cities . . . This has been made possible by Her Majesty's readiness to undertake a most extensive flying programme, which includes 35 separate flights totalling just on 10,000 miles. Her Majesty has approved the programme substantially as submitted by the Commonwealth and State Governments. Some slight variations were made at the suggestion of the Queen, who examined the itineraries with the most lively interest and in the closest detail. The programme will take Her Majesty and His Royal Highness to Cairns, near the northernmost part of Australia, to Hobart in Tasmania, to the richest pastoral, agricultural and dairy areas, and the most populous industrial centres, and to the scenic beauty of the Great Barrier Reef, off Queensland, and the Blue Mountains of New South Wales."

For 28 of the 35 flights the Queen and the Duke of Edinburgh will fly in a specially modified Dakota of the R.A.A.F. Altogether, the Royal Flight specially formed for the tour will consist of six Dakotas, two prepared for the Queen's own use, and four held for her retinue and for baggage. All the aircraft are drawn from No. 86 Transport Wing.

The remainder of the flights will be made in civil airliners,

The marine air base at Laucala Bay, Fiji, showing a Short Solent of the type in which the royal party will fly across the island, and afterwards continue to Tonga. This, it will be remembered, is the Pacific island ruled by Queen Salote, who visited London for the Coronation.

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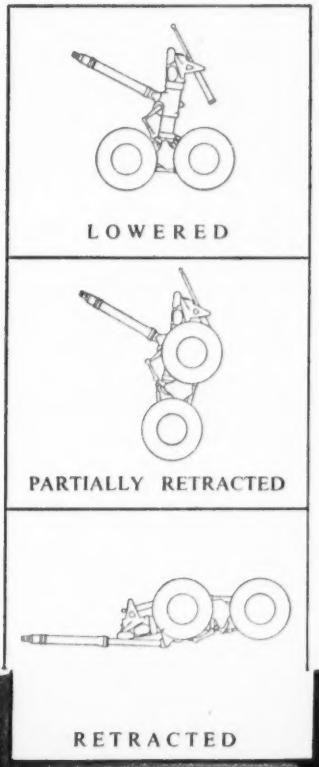
Landing Gear



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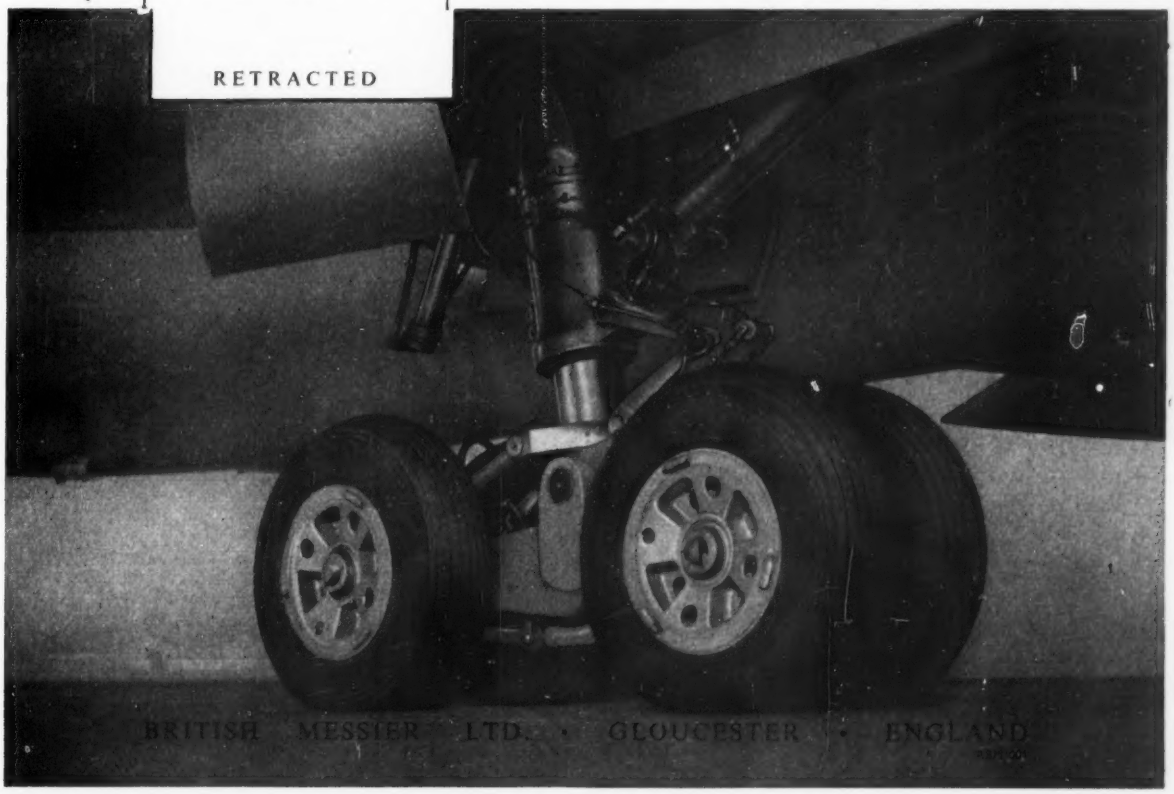

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Paraparaumu airfield, which Her Majesty will use during her stay at Wellington, New Zealand.

The crew of the Royal Australian Air Force Dakota. Left to right: S/L. J. G. Cornish, captain; Sister G. E. Bury, stewardess; F/L. T. C. McGrath, signaller; S/L. C. W. Brackenridge, navigator; P/O. R. Newson, co-pilot.

THE ROYAL TOUR OF THE WORLD . . .

particularly the longer journeys, such as that from Adelaide to Kalgoorlie (1,000 miles), and the only over-water flight, from Launceston, Tasmania, to Melbourne. This oversea flight will cover a distance of about 300 miles and will be made in a four-engined aircraft.

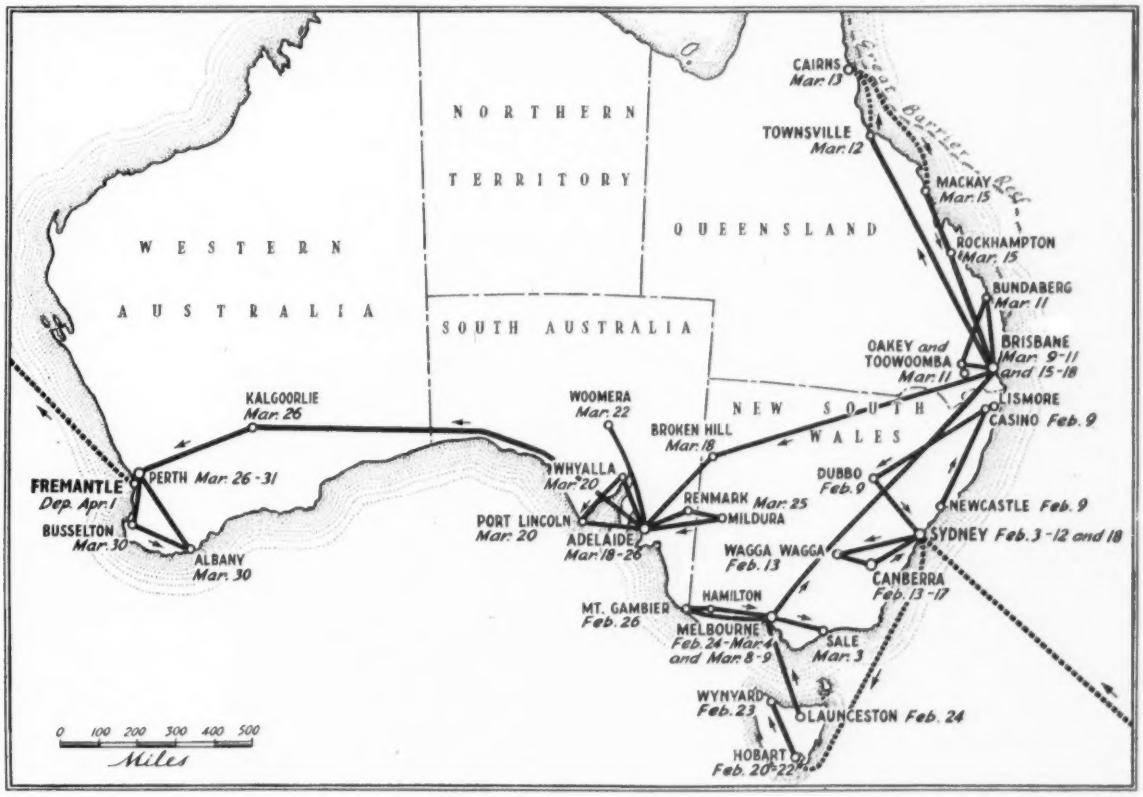
On Saturday, February 13th, the royal party will land at Canberra after flying from Wagga Wagga. There, on February 15th, Her Majesty will hold an investiture at Government House. At an official reception she will then interview a delegation from the Commonwealth Territories, Northern Territory, Papua, New Guinea, Nauru and the Norfolk Islands. The delegation has been arranged because it was impossible for the Queen to visit these territories. In the afternoon of February 15th, Her Majesty will exercise her right as Sovereign and open the Commonwealth Parliament.

As the accompanying map shows, the Queen will visit practically every centre of population in Australia and reach some of the most outlying communities in a few hours by air. These she would in all probability have been unable to visit by any other form of transport. The Duke of Edinburgh will make a visit by air to Woomera, the centre of the weapons testing range, and he will on another occasion make an inspection of the Flinders Naval Base, near Melbourne.

Finally, after using Perth as a base between March 27th and 29th, and seeing many of the outlying communities in the area, the royal visitors will sail from Fremantle for Colombo on April 1st.

Ceylon, Africa and the Mediterranean.—From Fremantle the Queen and the Duke of Edinburgh will travel in the liner *Gothic* across the Indian Ocean, visiting the Cocos Islands on April 5th, and arriving at Colombo in Ceylon on April 10th. There they will visit Polonnaruwa, the ruined city of King Parakrama the Great. On Easter Day, April 18th, they will

In Australia the royal visitors will make 35 flights covering nearly 10,000 miles. Their routes are shown on this map of the Commonwealth.



A Canadair Argonaut (Rolls-Royce Merlin engines) of the type in which the Queen and the Duke of Edinburgh will fly from Aden, via Entebbe, to Tobruk.

A D.H. Heron of the type in which the royal visitors will fly from Rotorua to Gisborne in New Zealand.

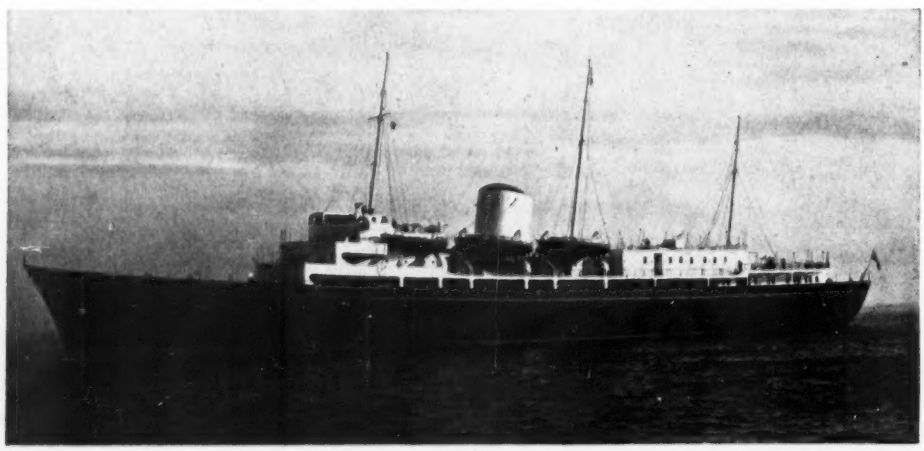
THE ROYAL TOUR OF THE WORLD . . .

travel by road to Kandy, and on Easter Monday will watch the Peranera ceremony from the Octagon tower of the Buddhist Temple of the Tooth. On April 20th the Queen will return to Colombo and on the following morning she will hold an investiture at Queen's House. In the afternoon the royal party will embark in *Gothic* for Aden. On April 27th, when the liner reaches Aden, the Queen and the Duke of Edinburgh will disembark from her for the last time. After a tour of the Aden Protectorate, they will board a B.O.A.C. Argonaut and fly to Entebbe in Uganda, arriving on April 28th. Here they will spend three days, during which they will meet many of the people of the territory and inspect the work proceeding on the great Jinja dam and hydro-electric station. They will then leave Jinja airfield in a Dakota of East African Airways Corporation and return to Entebbe. On the evening of the following day, they will again board the B.O.A.C. Argonaut and fly to El Adem, Tobruk. No decision has yet been taken on the particular aircraft or crew for this section of the royal tour. B.O.A.C. run a regular Argonaut service between London and Aden on behalf of their subsidiary, Aden Airways. No extensive preparations for this flight are therefore necessary and B.O.A.C. will not select the aircraft and crew until a few weeks before the date of the journey.

As in so many other instances during the tour, the visit to Uganda was made possible solely through the use of air transport. The journey from Entebbe to Tobruk is normally accomplished by means which would have been impossible for Her Majesty. This will not, of course, be the Queen's first visit to Entebbe. After the cancellation of her journey to Australia, when the death of her father, the late King George VI, caused her immediate return to London, she flew from Kenya to Entebbe by Viking, and was there met by the royal Argonaut in which she returned to England.

At Tobruk the Queen and the Duke of Edinburgh will board the newly completed royal yacht, *Britannia*, for the journey home. On the way, Her Majesty will visit Malta (it will be her fifth visit to the island) and Gibraltar, where she will receive the keys from the Governor and unveil a plaque at the Colonial Hospital in memory of her father, whose memorial in Gibraltar is to be a children's hospital.

Britannia will leave Gibraltar on May 11th and arrive in London on May 15th to complete the six-months' world tour. The Royal party will have covered about 50,000 miles during the tour, and of this distance about 20,000 miles will have been by air.



The new royal yacht, "Britannia," which will carry the royal party back to England from Tobruk.

The way things are shaping...

. . . it may well be child's play for the slide-rule types, who save old envelopes for jotting jet airliner designs on the backs of, to forecast the shape and speed of the aircraft of the *next* 50 years. As for us, we are sure that in A.D. 2003, when it comes to specifying paints and finishes, the designers, manufacturers and operators of aircraft will still be saying—

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INTERNATIONALITY

Co-operation between Nations in Aircraft Design and Manufacture

THE great anniversary which this issue commemorates has offered a unique opportunity for casting our minds back to survey the progress of powered aeronautics. The development of aircraft design can be clearly traced with the help of the main feature article of this issue, but power units and divers articles of equipment have also played their part through the years, and the narrative which follows introduces some of these major components by recalling the many occasions upon which engineers of one country have collaborated with those of another to develop a product distinctly better than any which had gone before.

Today—unhappily, from one aspect—the aeronautical research scene bears little resemblance to that of 1909, the year in which this journal began publication. It has become a vast and costly business (in the strictly commercial sense of the word) in which decisions based upon international contingencies, and orders and instructions to proceed, stem mainly from Government levels. Certainly there are very few who any longer treat aviation as a hobby.

It is both surprising and heartening to find that, in spite of this, unbounded good-will still exists between individual engineers of all countries, springing perhaps from a mutual enthusiasm which extends from the days when design, construction and testing of each aircraft was carried out by one man, or at most a small group of men. In some instances this fellowship still flourishes, even in the keenly competitive atmosphere today.

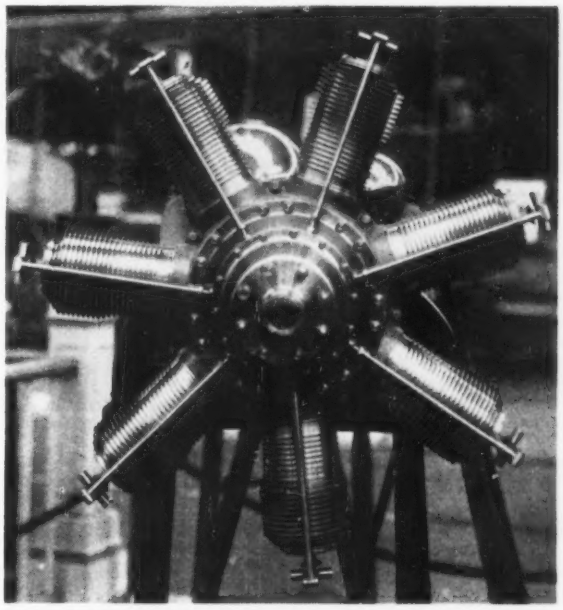
Originally, most of the progress in the fight against gravity was made by private enthusiasts of independent means. During the formative period before the first Great War, France was the acknowledged leader; French engines were largely responsible for this fact, and the Antoinette vee-eight series were bought by enthusiasts in many countries. An even greater step forward was the Gnôme rotary engine, illustrated on this page, which can almost be regarded as having provided the key to efficient and reliable powered flight. It first appeared in 1908, and later developments included the 100 h.p. Gnôme, the 80 h.p. Le Rhône and Clerget and the Gnôme *monosoupape*. All these were the subjects of international production licences and agreements, and they also led to our own Bentley rotaries.

As the Edwardian era receded it took with it what might be termed the age in which flight was an end in itself. By 1911 Britain already had the basis of a powerful aircraft industry which included names famous today: Avro, Blackburn, British and Colonial (Bristol), de Havilland, Handley Page, Short and Vickers. Already some of these makers were building for a world market. But one of the most widely used machines, and one on which hundreds of early pilots learned to fly, was the biplane designed in France in 1912 by the Englishman Maurice Farman. It was also built in Britain by the Aircraft Manufacturing Company, and became known as the Longhorn.

Many other French machines were built in England during the war, among them the Nieuport and S.P.A.D. (or, as it was often spelled, Spad). This country, in turn, supplied designs to others, and hundreds of Sopwith 1½-strutters and D.H.4s were built abroad, many of the latter being made in the United States with the country's new Liberty V-12 engine of no less than 400 h.p. —which was in turn fitted to certain British aircraft.

A case in which the wheel of co-operation turned full circle is that of the fine Porte flying-boats. In 1913 Lt. J. C. Porte, R.N., had become closely associated with Curtiss flying-boat development and during the war he supervised independent British development of Curtiss designs for the R.N.A.S. At Felixstowe, Porte and his team completely re-engineered the big boats, by far the most significant step being the adoption of the stepped planing bottom. This work led to the world-beating F-series and, in 1917, the F.5 was adopted by the U.S. Navy as its standard patrol boat, and licence-built in America with Liberty engines.

The Versailles Treaty of 1919 expressly forbade Germany to construct aircraft of a military character, and that country gradually began to establish factories or agreements in other countries which enabled her to evade the terms. But German civil aircraft went from strength to strength throughout the 1920s, and Junkers transports—sturdy, corrugated-metal monoplanes—were not only in world-wide use, but were built in several countries. One such, the G.24, had been disallowed by the Allied Control Commission, and it caused quite a stir when the prototype appeared in 1924;



This early Gnôme rotary, although a member of a tribe inherently foredoomed, was instrumental in assisting the early development of flight.

rumour had it that it had been constructed in Russia. Sweden and Switzerland were other associates in German work, and a forerunner of the *stuka* series of Ju87s, the Junkers K-47, was secretly built in Sweden.

Early in the 1920s Capt. Geoffrey de Havilland approached Maj. F. B. Halford, who had been principally responsible for the wartime B.H.P. engines, to see whether there might not be a future in making a four-in-line aero engine of some 60 h.p. De Havilland suggested that the Airdisco 120 h.p. engine might be "cut in half" for this purpose, and Maj. Halford concurred. Thus was the first Cirrus engine born; and what makes it international is the fact that the original A.D.C. engine had started life as the Renault 80 h.p. V-8. Thus, all the Cirrus engines, and also to a lesser extent the Gipsies themselves, had their earliest conception in a French engine of the Great War period.

At this time America had by no means concentrated on the air-cooled radial; the Liberty has already been mentioned, and another fine liquid-cooled design was the Curtiss D-12 with which the Schneider Cup-winning Navy racers of 1925 were powered. This 470 h.p. (550 h.p. in racing trim) V-12 set designers thinking. Mr. C. R. Fairey, as he then was, did more; he went to America and bought complete English rights for the engine, which his company built as the Felix.

At the same time the Fairey company obtained a licence to build the metal airscrew developed by Reed in America, and Fairey-Reed airscrews were themselves developed and sold in England. Thousands were used in such machines as the Oxford and Swordfish.

The Fairey Felix was the engine which assisted the Fox two-seat bomber to outpace the best fighters of the 1920s. Although only one squadron of Foxes saw service with the Royal Air Force, a Rolls-Royce-engined development was ordered by Belgium early in the 1930s, together with numerous Firefly fighters. An especially large contract—for £300,000—was agreed on condition that the aircraft were built in Belgium, by Belgian labour. Mr. Fairey lost no time in establishing a Belgian branch of the company, in a leased factory near Charleroi. The companies are still connected; Avions Fairey are now about to cease production of the Meteor in favour of the Hunter.

Many other engines achieved "internationality" during the 1920s; outstanding was the Bristol Jupiter, which was licence-built in France, Italy, Germany, Sweden, Belgium, Czecho-

INTERNATIONALITY . . .

slovakia, Yugoslavia, Portugal, Switzerland, Canada, Poland, Hungary, Spain, Russia and Japan. Not even British turbojets can yet equal this record.

Pratt and Whitney radial engines were from the start successful and they, too, were built in many countries. Germany built the Hornet from 1929, when B.M.W. obtained the Pratt and Whitney licence for that engine. As the years passed, the B.M.W. Hornet became an individual engine in its own right, and it was later known as the B.M.W. 132. Thus styled, it powered thousands of Luftwaffe aircraft, and also served as a basis from which was developed the excellent B.M.W. 801. Any who wish to examine German and American solutions to similar problems may care to compare the Double Wasp of the Thunderbolt with the B.M.W. 801 of the Fw190, for both engines have a common root.

Hawker biplanes were built and used, in various forms, from the arctic to the tropics, fitted with all kinds of engines from the shapely Kestrel to the huge Hornet radial. Belgian-built Faireys become more continental by their switch to the Hispano-Suiza engine. The final developments were the beautiful Fantôme and Féroce—biplanes good for some 270 m.p.h., and armed with cannon. Some were supplied to Russia, a country then beginning to make an aeronautical name for itself. The Hispano-Suiza engines were themselves modified and mass-produced in very many countries; in Russia, in fact, many of the in-line power units used in World War II were directly developed from French Hispano designs, and later variants are still in large-scale use in the Soviet Union.

Late in the 1930s Sweden decided not to order any more military aircraft abroad, but to become self-sufficient in this respect. Types already in use included the Northrop/Douglas 8A and the Hampden. The Ju86 was also used, fitted with Bristol Mercuries, and Junkers also received an order for this aircraft, in airliner form, from South Africa, the power units in this case being Rolls-Royce Kestrels. The domestic Ju86 transport usually had Junkers diesels, which had themselves been licence-built in Britain and France. Other engine/airframe collaboration between Britain and Germany concerned the He70, which Rolls-Royce used to test the Kestrel, and later the first Merlins.

A rather similar story can be repeated today in Spain. The Spanish nationalized industry has been building Me109 fighters and He 111 bombers for many years; and these are generally fitted with Merlin engines—war surplus in most cases.

Shortly before the outbreak of war in 1939 Alvis, Ltd., came to an agreement with the French firm of Gnôme-Rhône, by which the British company were enabled to build French radial engines under licence; the first three English-named units were the Pelides, Maeonides and Alcides. After the war Alvis brought another engine, the Leonides, to a high state of development, and it now serves as our only power unit in the range 400-1,000 h.p. A particularly interesting aspect is that Alvis, having discarded the original Gnôme-Rhône engines, have undertaken independent development of their own 14-cylinder two-row engine, which will shortly be in large-scale use as the Leonides Major. Meanwhile, the French concern, nationalized under the uninspiring title of S.N.E.C.M.A., have completed a precisely parallel development of an engine now marketed as the S.N.E.C.M.A. 14X.

Gnôme-Rhône, of course, were kept in production during the war in order to supply engines to the Luftwaffe for such aircraft as the huge Me 323 transport and the Hs 129 ground-attack type. "Co-operation" between the French and their German rulers produced many aircraft and engines some of which have been developed since 1945. Arsenal, for example, have turned the Junkers Jumo 213 engine into a very efficient 2,000 h.p. unit, which powers some of the big Noroit patrol amphibians.

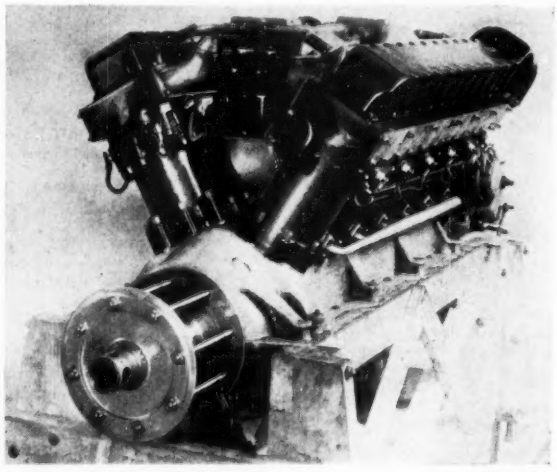
A case of France having to develop a basic German design, in addition to undertaking its production, is the Me 208, a tricycle-undercarriage light-transport. Messerschmitt farmed out all work on this type to the French industry, who fitted it with a Renault engine and, after the war, continued to develop it as the successful private-owner Nord 1100 series—named Noralpha. Sterner stuff was the huge Heinkel He 274, a variant of the He 177 with four separate engines; this was entirely developed and tested in France during and after the war. And the widely used Sipa S.11 and S.12 series of military trainers are direct developments of the Arado 396 trainers which were built in France for the Luftwaffe, their Renault engines being of original German Argus design. Similar engines are used in the Nord-built Martinet transports, which were designed as the German Si 204; and until recently France was actually building the evergreen Ju52/3m.

The expansion of the R.A.F. and French *Armée de l'Air* in 1937-8 caused both countries to turn to America. The Douglas Boston and Martin Maryland were initially developed against French contracts, while the famed Hudson was evolved from the Lockheed 14 transport according to British directions. Later, the Hudson was adopted by the American services.

With the outbreak of World War II, international co-operation in air affairs became vital. For the Empire Air Training plan, Oxfords, Ansons, Harvards and Tiger Moths were required in great numbers, and these types were built in various parts of the Empire. Some versions of these well-known stalwarts became quite different from the British original, particularly in the case of certain Canadian Ansons. Some of these had Vidal moulded fuselages of laminated wood and resin bonding, and Pratt and Whitney or Jacobs engines. The Tiger Moth could also become very un-British, with a Perspex canopy and Menasco engine.

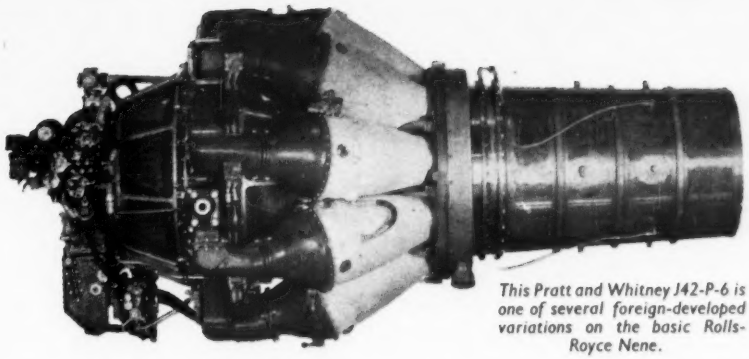
In armament especially, there has been remarkable collaboration between all nations. Before the war Britain had decided to standardize on the 20mm Hispano cannon and the 0.303in Browning machine-gun as the standard aircraft weapons, although neither was British. Several factories were established for the manufacture of these weapons, under supervision of the Ministry of Supply, and experts from both France and America assisted in getting modifications made and production started. During the war Britain and America worked closely on armament problems, and this country provided an immense amount of assistance in the developing of weapons systems for American combat aircraft. They in turn supplied very good twin-0.5in power-driven turrets to Canada and Britain for installation in bombers.

Possibly the closest Anglo-American collaboration was that connected with radar; by 1941 we had advanced so far that the techniques were completely new to America, but the latter's huge radio industry rapidly began to make itself felt. After suitable prototype airborne interception equipment had been sent over, America made her own modifications for installation in such aircraft as the Havoc and Black Widow. They in turn are now further ahead in production than we appear to be, and the latest British



The Schneider-winning Curtiss D-12, which was adopted in Britain as the Fairey Felix. With it came the Fairey-Reed airscrew.

Early examples of the Anglo-American Mustang, designed to British requirements and later fitted with British engines made in the U.S.A.



This Pratt and Whitney J42-P-6 is one of several foreign-developed variations on the basic Rolls-Royce Nene.

night fighters are equipped with American interception equipment.

The first target-sensing transponders were British and it was from them that America mass-produced proximity fuses. A joint development by both countries is the error-indicator carried by air-to-air targets. Radar bomb sights were another Anglo-American undertaking, in which both countries are today self-sufficient although in close touch. In the field of navigation, Britain developed the first hyperbolic pulse systems, such as Gee, from which has been evolved continuous-wave Decca, and American devices such as Loran.

Gas-turbine development was also very much a joint effort after the first discussion with the American General Electric company in the autumn of 1941. The original Whittle engine had been developed by Power Jets and later by B.T.H., Rover and Rolls-Royce. Independent work had been begun by Major Halford and the D.H. engine company, Metropolitan Vickers and Armstrong Siddeley, the two latter concentrating on the axial compressor which had been studied by Dr. Griffiths and the R.A.E. since 1926. On the enemy side, von Ohain and Heinkel (later with Hirth), Daimler Benz, B.M.W. and Junkers had all built turbojets; and the two latter companies were in production.

Later development saw the British concept independently developed by American G.E.C., who then turned to the axial layout and passed some of the work to Allison, who have since made many thousands of engines. D.H. engines have been converted to metric units and mass-produced in Sweden and Switzerland, while Rolls-Royce turbojets have been used as the basis for important units in France, America and Russia. The German engines have, in turn, been developed in France, Russia and Japan, in most cases largely by German engineers.

The two main licence-producers of Rolls-Royce engines are Hispano-Suiza and Pratt and Whitney, both of whom have gone on to make their own modifications to the basic Nene design. The latest Hispano Verdon and Pratt and Whitney J48 are perfect examples of national resource and character working on a standard British product—in this case the Tay, which Rolls-Royce dropped in favour of the axial Avon. Early members of the great Avon family are themselves now in production in several countries.

A particularly good example of co-operation is provided by the recent agreement between Rolls-Royce and the American Westinghouse company. Owing to severe technical trouble the Westinghouse turbojet production programme has fallen seriously behind schedule; Rolls-Royce are now in close association with Westinghouse and are not only providing considerable technical assistance but are prepared to let Westinghouse market, or manufacture under licence, engines of Rolls-Royce design. And this exchange will not be only one-sided.

Back in 1940 the rapidly growing firm of North American Aviation undertook the design of their first full-blooded fighter —to a British specification. This machine, the N.A.73 Mustang, was originally handicapped by its low-altitude Allison engine; re-engineered by Rolls-Royce to take the two-stage Merlin, it became one of the most efficient piston-engine fighters ever built. The Merlins for Mustang production were themselves built in America by the Packard Motor Company who also supplied engines for Canadian-built Mosquitoes and Lancasters and for a variety of Curtiss fighters.

The first American jet aircraft, the Bell XP-59, was fitted with American-built Whittle units; but the excellent Lockheed XP-80 first flew with the Halford H-1 turbojet which was later known as the Goblin. This was international co-operation in the fullest sense, for de Havillands actually diverted the only available engine cleared for flight in order that the Lockheed might take the air in the shortest possible time. Lockheed turned the tables on Britain when Rolls-Royce borrowed a production F-80 in order to test their Nene turbojet, later in 1944. Today two of the F-80's descendents enter the story: the F-94C Starfire uses an American-developed version of the Rolls-Royce Tay, while the T-33 is licence-built in Canada with the Nene.

These T-33s are built by Canadair, Ltd., at Montreal, who will always be remembered for their magnificent effort in providing a considerable number of Merlin-powered transports, based on the DC-4 and DC-6, in a remarkably short time. These machines, which today form the backbone of B.O.A.C. and Trans-Canada Airlines, are full of American and British equipment, much of which was specially developed for this aircraft. There is a possibility that our own Britannia will in turn be licence-produced by Canadair, possibly with some American equipment on board, to fill a variety of rôles.

Canadair have now built over 700 Sabres under North American licence. Present production is powered by the Avro Orenda, which is itself an engine developed by engineers from many countries. The Sabre is another international machine, and in Australia a development is in production powered with the Australian Avon and armed with Hispano 30 mm guns.

The Sapphire is being built in large numbers as the Wright J65, in which form it differs in many details from the basic product from Coventry. Armstrong Siddeley co-operated closely with Wright in overcoming such things as blade resonance; it is not generally known in America that the British firm had already developed suitable steel blading for the Sapphire compressor before the licence agreement was signed. Wright are also developing the Bristol Olympus under the terms of another licence agreement which is likely to benefit both companies.

The unique qualities of the Canberra rapidly brought it to the attention of the U.S. Air Force for whom the Martin Company are now producing a suitably Americanized development. Some of the features developed by Martin are in turn being introduced to later marks of British Canberra. Australia are also turning out Canberras with their own modifications incorporated.

In production at Toronto is the Avro Canada CF-100 Mk 4, for which the Hughes Company have developed a complete nose-section housing radar first-control equipment. On the other hand, the undercarriage is of true British Dowty design; the engines are Avro Canada Orendas. In passing it may be noted that Solar of California have been called in to develop an Orenda afterburner.

Other Canadian/British aircraft include the de Havilland Chipmunk, which has also been built in England at Chester, and the highly successful Beaver, hundreds of which have been supplied to the U.S. Air Force and Army and which has also been developed to take the Alvis Leonides engine. The Leonides is also fitted to the Westland Dragonfly series of helicopters which are, of course, based on the Sikorsky S-51. Westland are now producing the bigger S-55—which they have named the Whirlwind—later versions of which will have the 14-cylinder Leonides Major.

European jet co-operation includes the licenced production of de Havilland engines by several firms in Switzerland, Sweden and Italy, those built by the Fiat Company being supplied to France for installation in French-built Sea Venoms. Several of the Turboméca gas turbines are now being built both in Britain and America, and their use as auxiliary boosters for airliners has been developed with the assistance of operators from as far apart as Israel and Brazil. A special mention should be made of the work by Air Service Training in the provision of flying test-beds for foreign gas-turbine manufacturers, typical examples being the Dovern-Lancaster for Sweden and the Atar-Meteor for France.

Anglo/American power-plant equipment includes a whole host of units designed by such firms as Dowty, B.T.H., K.L.G., Rotax, Plessey and Lucas. We may single out for mention the starters originally developed by Rotax for large fighter turbojets. These were to be licence-produced in America by Bendix, but difficulty was experienced in obtaining the necessary supplies of cordite. Accordingly the American company redesigned the Rotax unit to burn a petrol/air mixture and—the wheel having turned a full circle—Rotax now licence-produce the Bendix development.

France, Britain and America have co-operated in the development of lightweight batteries, while Sweden and Switzerland have added their knowledge in the perfecting of several new guns and rockets. Other companies whose engineers have worked in close co-operation include Redifon/Curtiss Wright, Rotol/AiResearch and de Havilland/Hamilton Standard. Sometimes one company undertakes research on both sides of the Atlantic; thus the "wave-type" wheels developed by Goodyear for the Valiant B.Mk 2 were originally developed in America.

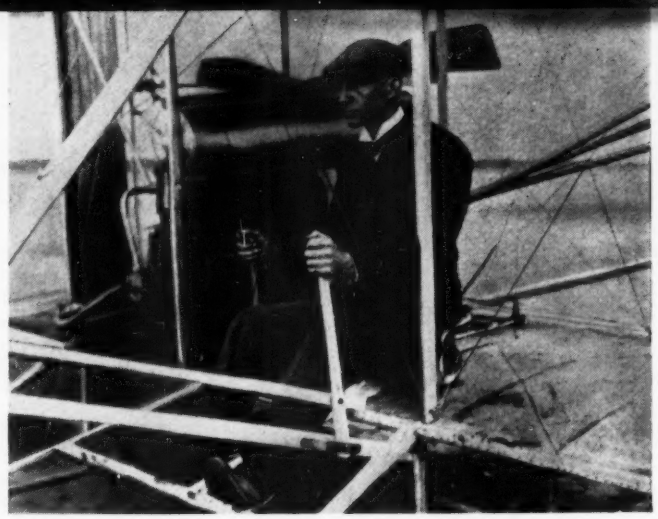
Among military equipment are such items as ejection seats, targets and the products of Flight Refuelling, Ltd., examples of which are now in production in America, and other countries, to British design. In return we have learned much from the U.S.A. in the design of flying-clothing for high-altitude, high-speed flight. The reader should also note the close technical co-operation between the Royal Navy and U.S. Navy in the application of the British-developed steam catapult and angled deck for aircraft carriers. The first ships to embody these devices—H.M.S. *Perseus* and U.S.S. *Antietam*—were used for joint trials.

It is a particularly significant fact that Britain and America are in such close harmony in the development of new solutions to their common problems.

WILBUR WRIGHT AS I REMEMBER HIM

By HARRY HARPER

MANY people, both here and in America, will be participating in various Wright Jubilee celebrations during the coming week; but among them will be few with any personal recollection of Wilbur Wright, who died in 1912 (his brother Orville survived until 1948; in 1944 he had made his last flight—in a Constellation). One of the few is Mr. Harper, who here recalls a postprandial conversation with Wilbur Wright a few years after the momentous event at Kitty Hawk.



". . . a lean, strong-featured face, bronzed by wind and sun": Wilbur Wright in the biplane he flew in France in 1908.

IT is not my intention to tell again in detail a story which has been told often enough already. What I *am* going to recall is something not to be found in any of the history books: it is my own recollection, still vivid, of sitting over a meal at a little French café on an evening towards the end of 1908. Facing me across the table was Wilbur Wright.

He had brought one of the Wright biplanes to France in the summer of that year to give demonstration flights arranged by a French syndicate headed by the genial and energetic Mr. Hart O. Berg. And it was to Mr. Berg that I had gone one day on arriving in Paris, because it was he who knew most about what Wilbur was doing on the artillery-range at Auvours, near Le Mans, where the aviator was carrying out his tests. That same day Mr. Berg and I, with a few others, had travelled down by train to Le Mans, and then motored with M. Léon Bollée, the French motor-car maker, to the spot where Wilbur had his shed.

I should have liked, had space allowed, to recall the profound impression made on my mind by watching Wilbur in flight that evening; but that is a tale I have told before, and I want to concentrate here on the talk I had with the great man afterwards, and of the light it threw on his and his brother Orville's research work.

Apart from the altogether exceptional skill he showed in piloting his biplane, Wilbur Wright was a man of remarkable personality. Slim and spare of figure, very erect always in his carriage, he had a lean, strong-featured face, bronzed by wind and sun; and the things that struck one chiefly about him were his keen, watchful, far-seeing look—the kind you see in the eyes of seafaring men—and his quiet, very deliberate way of speaking. He had a way of hesitating for a moment before answering any question; nothing short of complete accuracy, either in talking or in flying, was good enough for him.

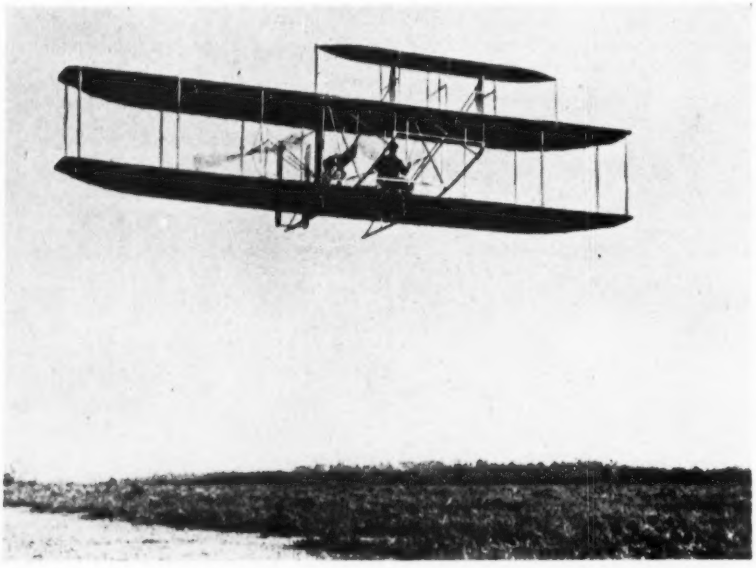
Although he found himself in the limelight practically from morning till night, never once did I see him lose patience with anybody, and he would endure with an unvarying politeness even the most persistent of his questioners. Yet another revealing sidelight on his character was the fact that though many offered quite large sums to be allowed to fly with him as a passenger, he would never on any occasion accede to such requests; all the passengers he did take up were those he had invited personally, no question of payment ever being considered by him.

How was it that Wilbur and Orville Wright—two quite unknown young men, without outside assistance of any kind, and entirely at their own expense—managed to solve a problem which had baffled so many men before them, even after the invention of the internal-combustion engine?

The answer is simple. It is just that the brothers set out to investigate, patiently and unhurriedly, the problem of flight in each of its aspects, and not to be content with any answer to any question until both were satisfied they had worked out the right solution. As I talked with Wilbur in the café that evening, he referred more than once to the way he and Orville took some particular question and tossed it from one to the other until they really had got it sorted out. Which reminds me, incidentally, of a remarkable thing about early flying: the way in which team-work by brothers seems to have worked such wonders. Away back in hot-air balloon days there were Joseph and Etienne Montgolfier; then came Otto and Gustav Lilienthal; the Wrights; the Voisins, Charles and Gabriel; the Farman brothers, Henri and Maurice; and the successful team-work in this country of the Short brothers.

The previous experimenter to whom the Wrights owed more than to anybody else was undoubtedly Otto Lilienthal, often called "the father of flying." It was he, as Wilbur recalled, who had said that to design a flying machine was one thing and to build it another, but that to learn to fly it was everything.

How patient Wilbur and Orville were in all their initial researches is shown by another thing which Wilbur told me. He said that if one factor more than another contributed to their ultimate success, it was the research they carried out beforehand on the ground. He was referring, in particular, to their building of their own small wind-tunnel, in which they investigated, very thoroughly and patiently, the characteristics of wing surfaces of different shape, cambers, incidence and aspect-ratio. Lilienthal had compiled tables based on his many experiments with birdlike gliders; but when Wilbur and Orville began to translate some of this data into the first of their biplane gliders (which they flew as kites, controlling them with cords from the ground) they were disappointed to find that the lift which these surfaces gave was far less than they had reckoned it should be. And so they spent month after month testing scores of scaled-down wings in their tunnel, seeking some really dependable data as to the magnitude and direction of forces acting on a lifting surface. It was in this way that, by degrees, they evolved wings of a more efficient



The biplane "in full flight"—to use a common phrase of the period—at Le Mans in 1908. During his five months' stay Wilbur Wright made numerous flights, many with passengers.

R.A.A.F. official photograph

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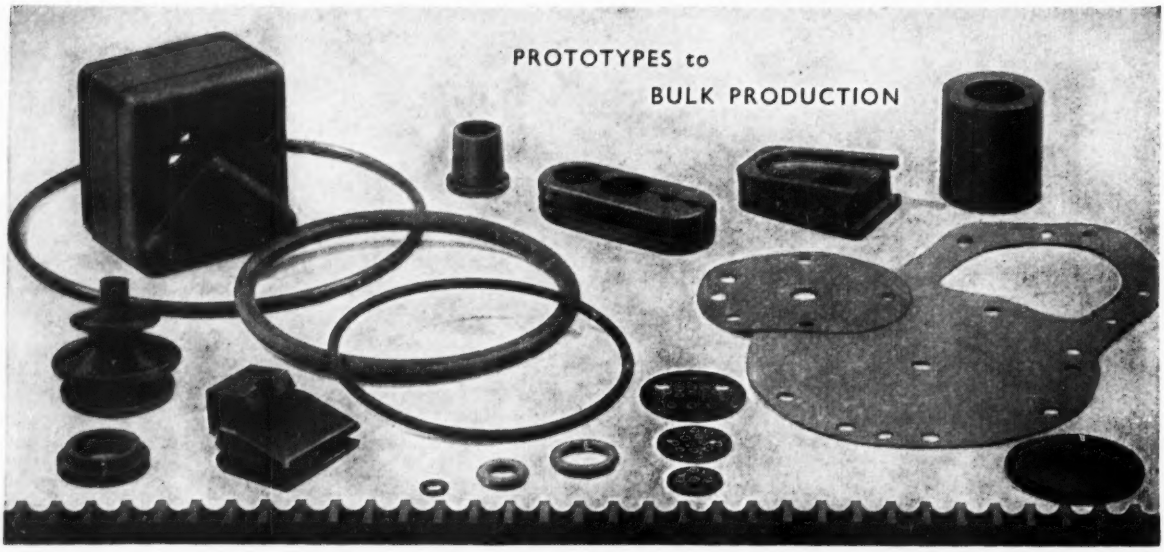

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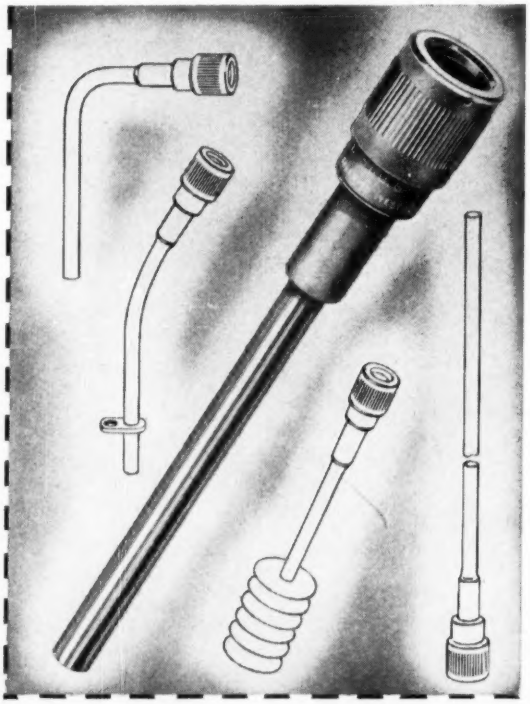

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WILBUR WRIGHT . . .

profile than those used by Lilienthal, Chanute and others, improving constantly on the figures they obtained for lift and drag and for controlling the travel of the centre of pressure.

Not all their experimentation was plain sailing. More than once, during the phase of their earliest investigations, they met disappointments that almost induced them to abandon the work—more especially as they could not devote their whole time to it, for they were concerned all the while with ensuring their livelihood by building and selling bicycles.

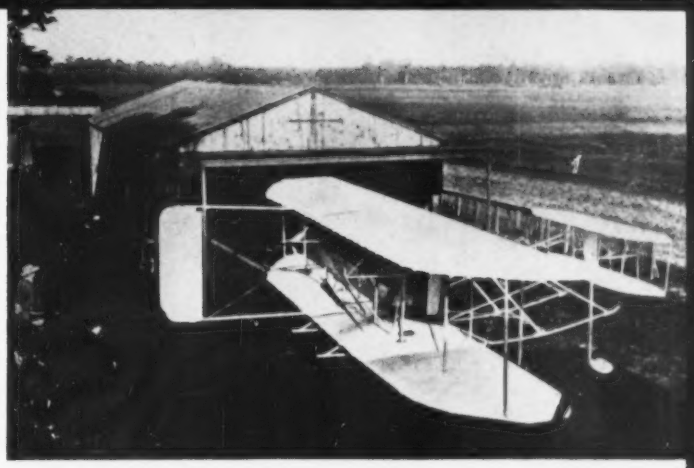
Wilbur spoke of the encouragement they had received from that other far-seeing research-worker and friend of theirs, Octave Chanute. He was convinced that the two brothers were working on the right lines, and told them so. But Wilbur smiled rather grimly as he recalled the discouragement that sometimes came from studying the unhappy ending to the experiments of other early workers. Maxim, for example, had been obliged to give up after spending many thousands of pounds. The Ader machine had been a failure, while Lilienthal in Germany, and Pilcher in England, had both been killed while gliding; and even the persevering Chanute had ceased his gliding tests.

But the Wrights were heartened when they came to test a glider embodying the results of their wind-tunnel work. Its surfaces gave a better all-round performance, and they found they could extend considerably the length of their glides down the sand-hills at Kitty Hawk, North Carolina.

During all their gliding they were, of course, constantly developing and improving their method of control, evolving their twin-surfaced front elevator, the twin rudders, and their method of warping the extremities of the mainplanes to provide lateral stability; this last system they subsequently linked up with that of the rudder to secure combined control of turning and banking. (Later, finding it unsatisfactory, they discarded this linkage.) Always they bore in mind that it would be useless to think of fitting an engine and airscrews to any glider until they were able to exercise full control, even in high or gusty winds.

I recollect how Wilbur stressed this point. Previous experimenters with motor-driven machines had, he said, tried to take them off the ground without having served sufficient preliminary apprenticeship in the art of balance and control. Lilienthal had emphasized the importance of this preliminary gliding, pointing out how young storks had to learn to balance themselves in the air after running forward into the wind and flapping their wings; and, as Lilienthal had himself observed when watching these young birds, they often suffered falls before they became proficient flyers.

As I sat listening to Wilbur Wright, I began to see the pattern of the brothers' research emerging clearly: first that fundamental quest for the right kind of surface; next the long spell of gliding to learn to control a winged machine when it was moving through the air; then—and not until then—the imparting of power.



Outside the hangar at Le Mans. Though the general arrangement of the machine was similar to that of the earliest Wright biplane, it is apparent in this picture that the booms carrying the front elevator are rather longer. The four-cylinder-in-line engine weighed some 200 lb and developed about 30 h.p. at 1,200 r.p.m.

When the time came for this culminating adventure, Wilbur told me, they had approached pioneer motor-car firms in America in an endeavour to get a sufficiently light petrol engine built for them. But the reactions they obtained were far from satisfactory, and so it was that they decided to build, in their own workshop at Dayton, that small, simple, four-cylinder water-cooled unit which was to make history. Developing between eight and twelve horse-power for a weight of 240 lb, it eventually did all they wanted it to do; but they also had to design a pair of long-bladed airscrews—revolving in opposite directions to neutralize torque—operated by a chain drive; these they found to give a thrust efficiency of just over 60 per cent.

Whenever I recall that talk with Wilbur, the most wonderful part of a wonderful story seems to me the way in which he and Orville had managed to carry out all their risky early gliding without once sustaining anything in the nature of serious injury; and of how, when at last they fitted an engine to their machine, they each took this powered craft off the ground and flew at the very first time of asking, not only handling it successfully, but also bringing it back to earth without any damage to it or to themselves.

It was after those first flights, on that history-making morning of December 17th, 1903, that—quoting Orville Wright's own words—"we packed up our goods and returned home, knowing that the age of the flying machine had come at last."

CORRESPONDENCE

The Editor of "Flight" does not hold himself responsible for the views expressed by correspondents in these columns; the names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

The Long Way Round

I WAS very interested to see the interview with Mr. John Elliot, in the issue of November 13th, dealing with the problems of passengers arriving at London Airport. I note that he gives a figure of 845,000 passing through the airport during the year, and I am wondering how many of these were conveyed to London, though they really wished to travel in the opposite direction—thus adding to the congestion.

We live on the far side of London Airport, almost on the boundary and certainly within the circuit, yet there is no bus service from the airport to Staines or beyond. Staines is the nearest large town (with the exception of Hounslow) in the area, yet a passenger arriving at London Airport and wishing to go westwards through Staines has to go *via* either Hounslow or Slough, both journeys of several miles in wrong directions. It seems to me that as Staines has already a very good train service some of these 845,000 passengers might prefer to travel that way rather than through London.

Our attention has been drawn to this point by visitors arriving from the Continent, for whom we have to send a car to wait at the airport, as they are quite unable to complete the last few miles of the journey by public transport in less than a couple of hours unless we do this.

EDWIN SHIPLEY,
Egham, Surrey. Wing Commander.

"Life with the Dales"

YOUR correspondent Ian Allen, in his letter "Life With the Dales" (November 6th) is mistaken in assuming that Bob Dale will pass his examination easily, or that this programme has disregarded the initial qualifications of a radio mechanic, or that it in any way underrates the abilities necessary to obtain a Radio Maintenance Engineer's Licence.

The writers of this programme went into the whole aspect of this story most carefully with the Ministry of Civil Aviation and with the staff of the Engineering Base at B.E.A. before embarking on it.

Attention has been drawn in several episodes to the fact that Bob has to work two or three evenings a week at home and for that purpose has fitted up a room over the garage where he can study in quiet; and your correspondent need have no fear that this programme will cast a cheap reflection on the abilities of radio engineers in general.

ANTONY KEAREY
B.B.C., London, W.1. ("Mrs. Dale's Diary").

Training Airline Pilots

SO W. J. D. Eassie (October 30th) is yet another of the types who believe that only the ex-Service pilot can make a commercial pilot.

I often wonder how many commercial pilots today would have taken up flying as a career, had it not been for their Service training. I wonder if they would have been prepared to pay even to obtain their P.P. Licences, hoping—as quite a number of my friends do—that one day a scheme such as that suggested by Capt. Brice (October 16th) would enable them to get a little farther up the ladder. Chaps who for various reasons have been unable to acquire pilot hours and training in the Services, but who in many cases have spent quite a number of years at the engineering

CORRESPONDENCE . . .

side of the aircraft business, have been keen enough to spend hard-earned cash on learning to fly, hoping eventually to obtain in some way the hours necessary for a Commercial Pilot's Licence.

Will they ever be given the chance to obtain the hours and training, which they can never even hope to pay for out of their own pockets? Or will they just have to carry on the good work in the hangar, and be content with taking the girl friend for the odd half-hour's trip at the weekend?

Camberley, Surrey. J. E. HAWKINS.

Rhodesia's Fledglings

I AM sure many Mount Hampden and Heany cadets of the early nineteen-forties will join with me, as one who progressed from the "fledgling" to "wings" stage, in thanking C. Nepean Bishop ("The Fledglings of Rhodesia," November 20th) for reviving memories of exciting experiences at those two stations.

Some of us, who now tend to resemble the Rhodesian secretary-bird both in appearance and existence, had probably forgotten that we ever did a first solo.

Now we may gaze thoughtfully at our small children, at play upon the rug by the fireside, and make a mental note to tell them how father took to the skies—when they are old enough to appreciate the point. Of course, by that time, speeds of 110 knots may seem somewhat odd.

Come, gentlemen, let us away to dust the jolly old log-books!

Fair Oak, Eastleigh, Hants. THOMAS C. HUTTON.

FORTHCOMING EVENTS

Dec. 12. British Interplanetary Society: "Techniques of Protecting and Cooling Rocket Motor Walls," by H. Ziebland, A.M.I.Mech.E., Dpl.Ing.

Dec 12. British Interplanetary Society (Midland Branch): "The Moon," by E. J. Burden.

Dec. 15. R.Ae.S. Section Lecture: "High-speed Wind Tunnels," by D. L. Ellis, B.Sc., A.R.T.C., F.R.Ae.S.

Dec. 15. R.Ae.C.: Film Show.

Dec. 15. Rochester Flying Club: Annual dinner and dance to celebrate 50th anniversary of powered controlled flight.

Dec. 17. R.Ae.S. Graduates' and Students' Section: Film Show (jointly with Inst. Pet.).

Dec. 17. R.Ae.C. and R.Ae.S.: Commemorative Dinner, 50th anniversary of Powered Controlled Flight.

Dec. 18-19. Institution of Production Engineers: Conference: "Problems of Aircraft Production" (at Southampton University).

Jan. 2. British Interplanetary Society: "Cosmic Radiation Hazards in Space Flight," by Dr. L. R. Shepherd, Ph.D.

Jan. 6. Institute of Metals: Informal discussion, "Lubricants for Non-ferrous Metal Working."

Jan. 7. R.Ae.S. Main Lecture: "The Fun of Finding Out in Flying," by Sir Leonard Bairstow, C.B.E., F.R.S., Hon.F.R.Ae.S.

Jan. 25-29. Institute of the Aeronautical Sciences; 22nd Annual Meeting, New York.

R.Ae.S. Branch Fixtures (to Jan. 6).—Dec. 11, *Preston*, Wright Brothers' Jubilee dinner dance. Dec. 14, *Halton*, Junior Members' Night. Dec. 17, *Chester*, dinner and film show to celebrate the 50th anniversary of powered flight. Dec. 17, *Bristol*, celebration of 50th anniversary of powered flight. Dec. 18, *Birmingham*, films. Dec. 21, *Brough*, Wright Jubilee Dinner and film.

Jan. 4, *Bristol*, "Review of Developments in Aircraft Equipment," by G. H. Dowty. Jan. 6, *Belfast*, joint meeting with Queen's University Film Society; *Luton*, Wilbur Wright Centenary film; *Brough*, "New Developments in Aircraft Production Engineering," by Professor J. V. Connolly; *Chester*, "Guided Weapons," by D. J. Lyons.

THE INDUSTRY

Short Bros. Appointments

ANNOUNCED by Short Brothers and Harland, Ltd., is the appointment of Mr. George T. Gedge as assistant general manager. Mr. Gedge joined the company in 1926 as an apprentice, and during the war he became superintendent at Cambridge, where the repair and modification of Stirlings was carried out. In 1946 he returned to Rochester as personal assistant to the managing director and was responsible for supervising the

Mr. Gedge.

Mr. Penney.

transfer of some 400 key personnel and thousands of tons of plant and equipment from Rochester to Belfast, a task which took two years to complete. He went to Belfast as production manager in 1948 and in 1951 was made works manager, a post which he has occupied until his latest appointment. Succeeding Mr. Gedge as works manager is Mr. B. Penney, who has been with the company since joining as an apprentice fitter in 1929.

Prize-giving at Warrington

TWO member-companies of the Owen organization, Electro-Hydraulics, Ltd., and Rubery Owen (Warrington), Ltd., operate a joint apprenticeship scheme of which they are justly proud. The administration rests in the hands of an executive committee under the chairmanship of Mr. L. Rumley, Electro-Hydraulics sales director, and consisting of Mr. A. W. Hill, general manager of Rubery Owen (Warrington), Mr. T. C. Wright, Electro-Hydraulics works superintendent, and Mr. George Archer, apprentice supervisor. About 100 apprentices constitute the normal establishment, and an average of 25 trained men are turned out each year.

This year's annual prize-giving, on November 26th, was an enjoyable function under the chairmanship of Mr. E. F. Edwards, A.C.A., secretary of Rubery Owen (Warrington). The prizes were presented by Mr. W. West, assistant managing director of Leyland Motors, who also delivered an impressive address.

The most important award was the Stanley Morris Memorial Prize, awarded for the first time this year. It is a perpetual award to be made annually to the best all-round apprentice; Stanley Morris was an apprentice who lost his life at Farnborough last year. Mr. C. W. Sharp, Electro-Hydraulics managing director, discussed the difficulty experienced in choosing a suitable form of memorial award and, in the end, a model D.H.110 was selected. The superb trophy was made by the apprentices themselves.

The recipient was R. H. Smith, and apprentices who received other awards at the prize-giving included the following:—

Electro-Hydraulics, Ltd.—*Group 1:* 1, C. Fox; 2, G. F. Molyneux; 3, J. Barlow. *Group 1A:* 1, A. L. Hatton. *Group 2:* 1, J. S. Johnson; 2, E. Statham; 3, D. F. Baddley. *Group 2A:* 1, A. J. Finch; 2, T. Rose; 3, D. J. Hardman. *Group 3:* 1, M. Astill; 2, B. J. Newton; 3, P. C. Fleming. *Group 3A:* 1, W. Lewis. *Group 4:* 1, A. Warburton; 2, E. Tomlinson; 3, C. F. Richards. *Group 4A:* 1, R. J. Lester. *Group 5:* 1, R. A. Phillips; 2, R. H. Smith; 3, D. H. Deakin.

Rubery Owen (Warrington), Ltd.—*Group 1:* 2, D. P. Hunter. *Group 2:* 1, E. Brett; 2, G. D. Thomason; 3, F. Tickle. *Group 3:* 1, D. A. Brown; 2, S. Fairhurst; 3, A. E. Jones. *Group 4:* 2, J. Harrison.

Special Awards other than the Stanley Morris Prize went to R. A. Phillips, A. Warburton and E. Tomlinson. In addition, over 100 prizes were awarded for technical-school examination successes and works efficiency.

IN BRIEF

Lucas-Rotax (Australia) Pty., Ltd. (G.P.O. Box 1628M, 81 Bouverie Street, Melbourne, N.3), have been appointed exclusive stockists and distributors in Australia of aircraft parts manufactured by Brown Brothers (Aircraft), Ltd., Northampton.

* * *

Amal, Ltd., Birmingham, state that Mr. C. L. Binks has been appointed general manager in place of Mr. T. W. Clibbery, whose retirement was recently announced. Mr. F. W. Clibbery has been elected a director and assistant general manager.

* * *

In table II of the article on *Polyesters in Aircraft* (November 27th) the temperatures quoted for test results with "Stypol" 16B/Fibreglass 181-114 laminates should have been headed "Deg F" and not "Deg C."

* * *

Wellworthy, Ltd., of Lymington, Hants—makers of pistons, rings, cylinder liners, "Al-Fin" cylinder barrels and other components and castings—have published a profusely illustrated brochure recording their growth over a span of 35 years.

* * *

The United Steel Companies, Ltd., announce that they have appointed Cdr. K. H. S. Cohen, C.M.G., as their European adviser. For some time the company has wished to make a closer study of trends in European industry and economics, and Cdr. Cohen is to undertake this work on their behalf.

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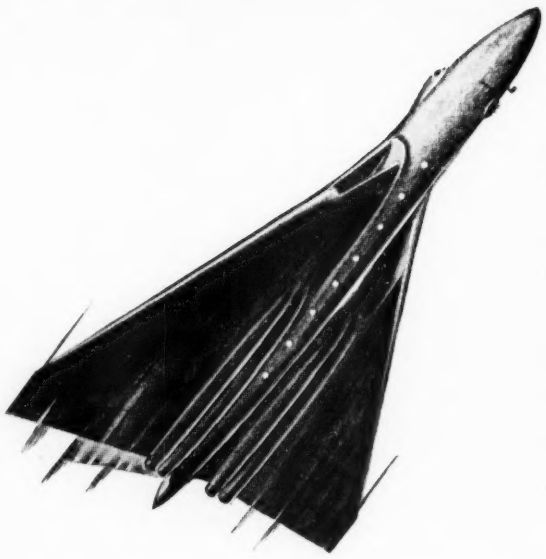

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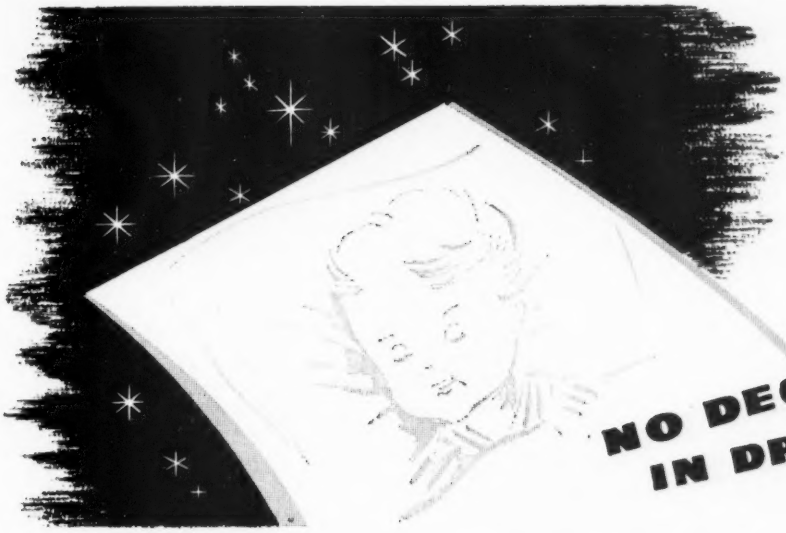

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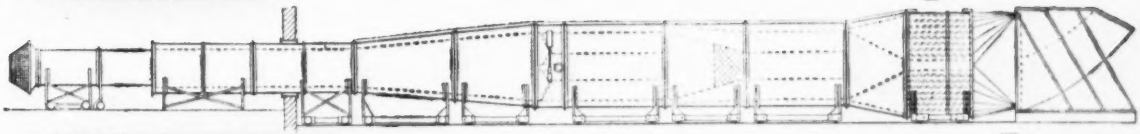

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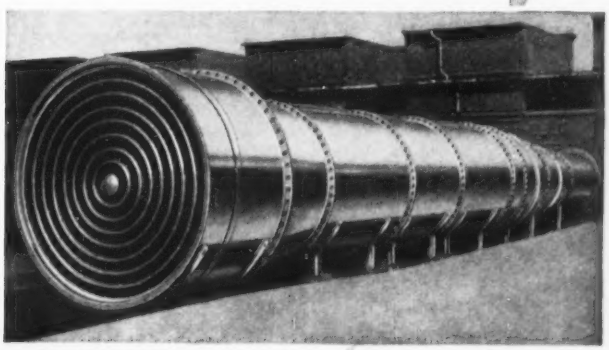

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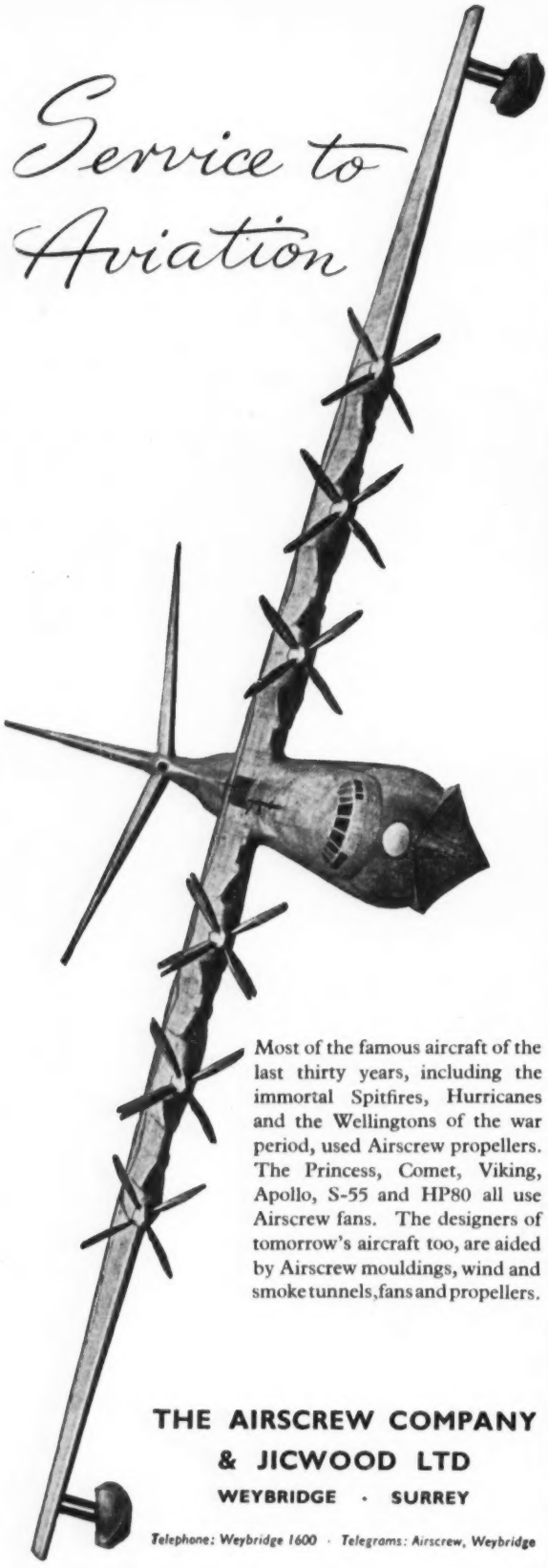

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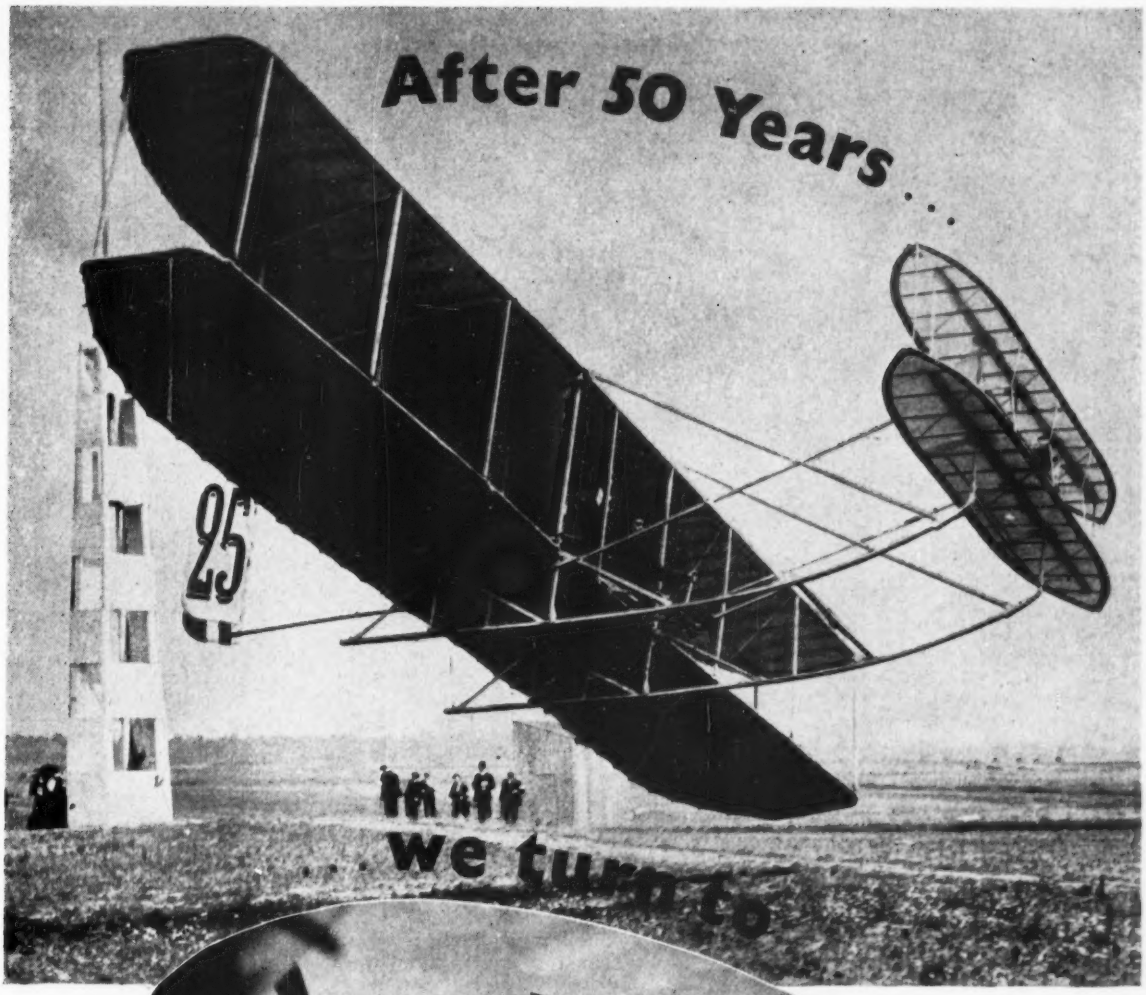

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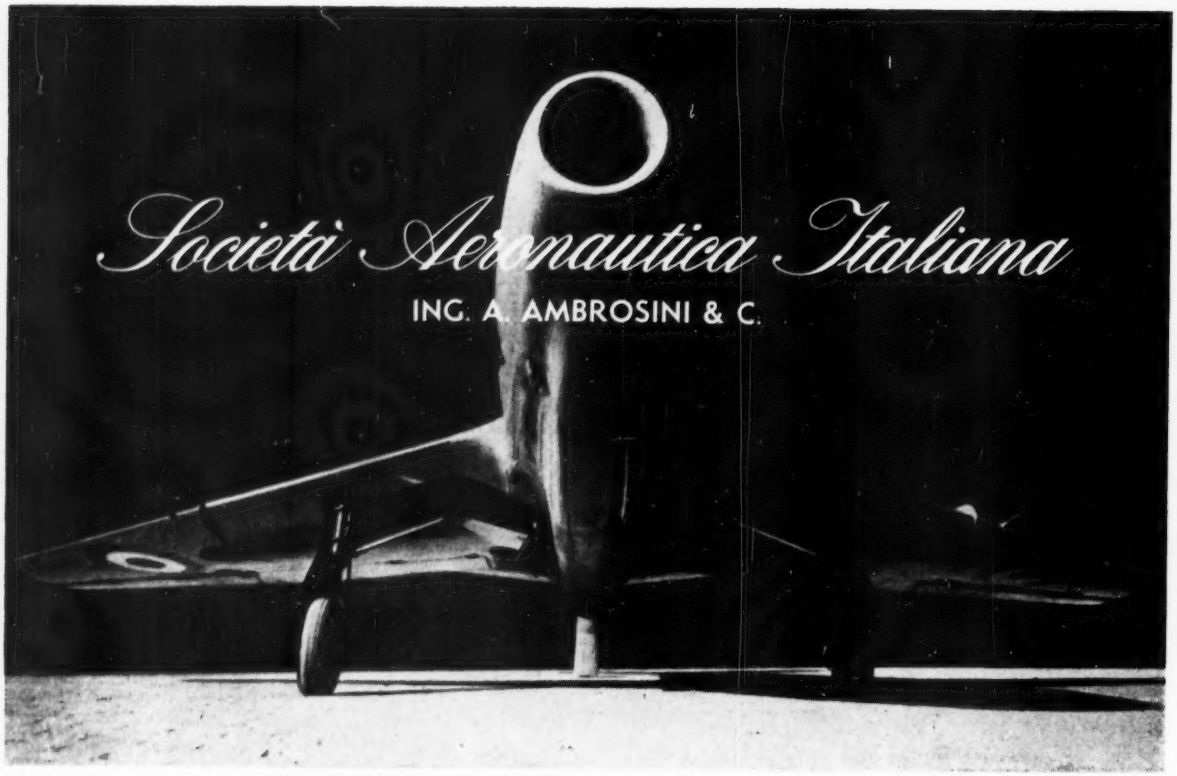

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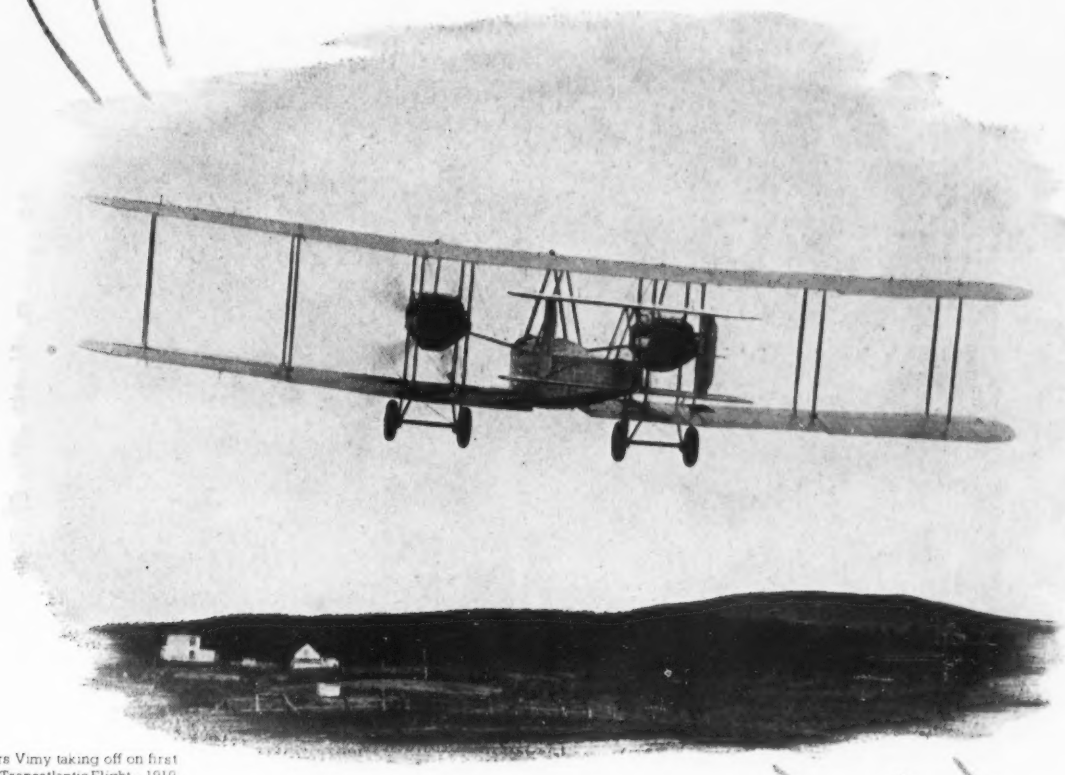

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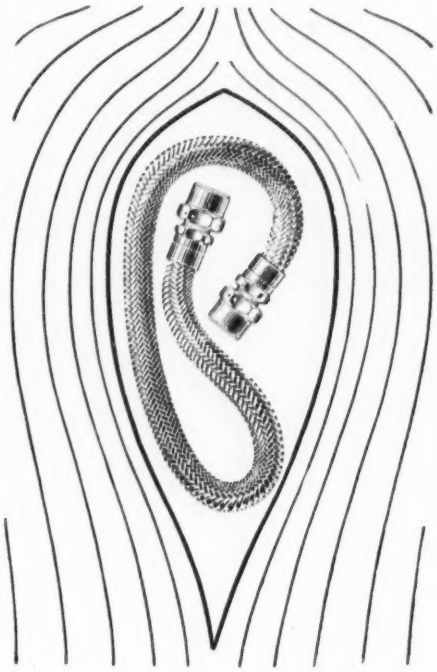

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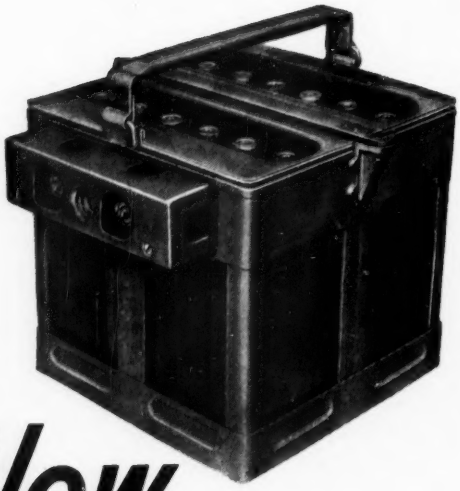

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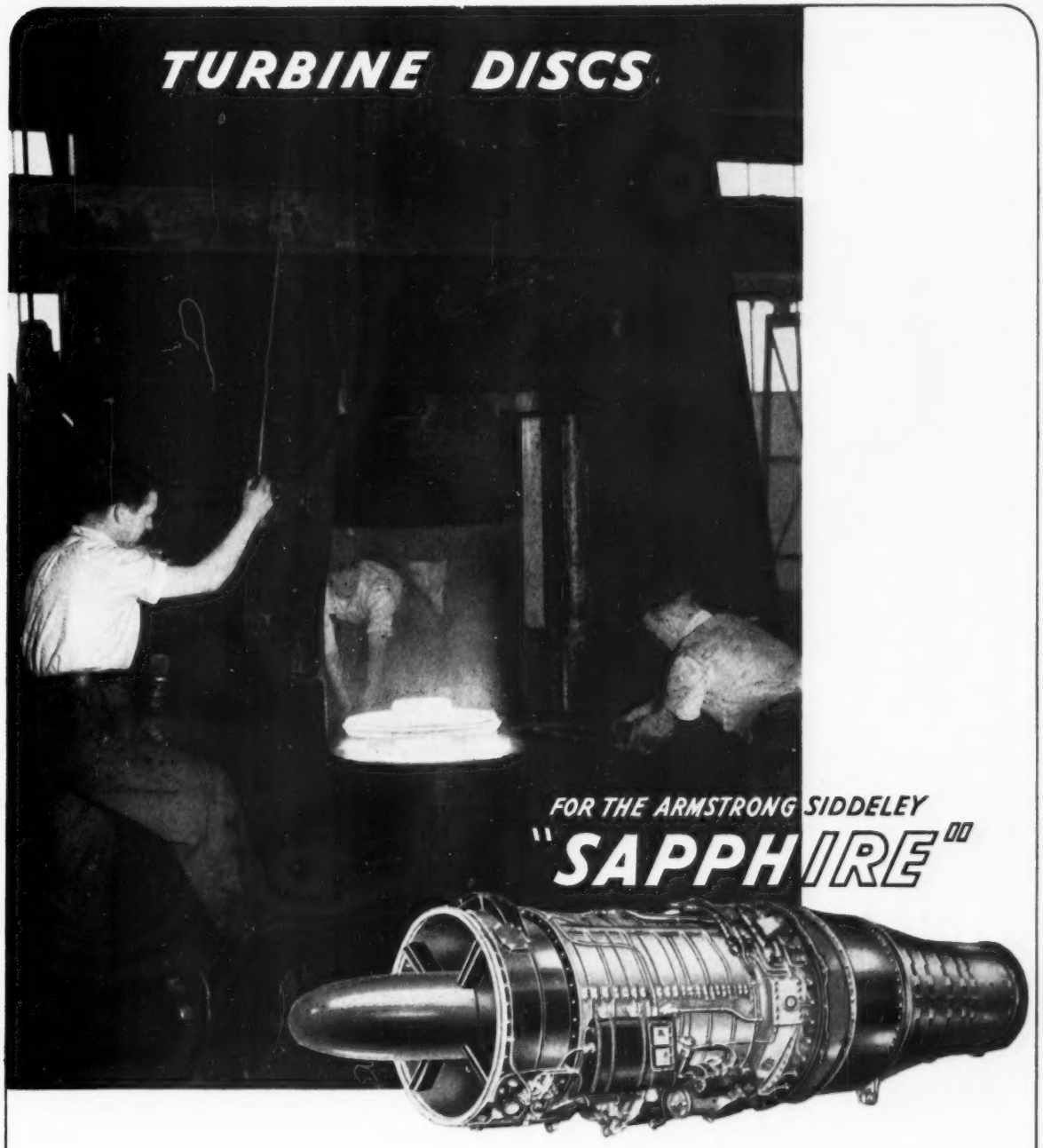

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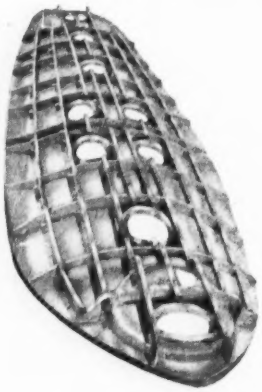

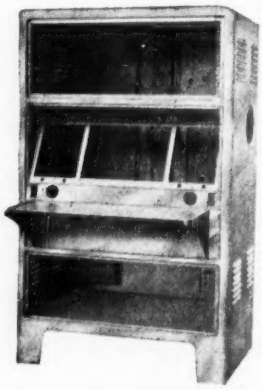

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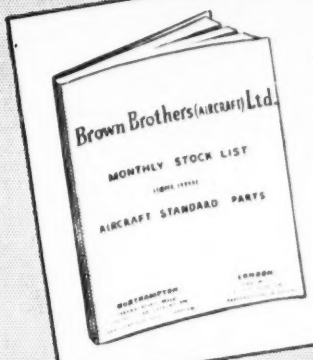

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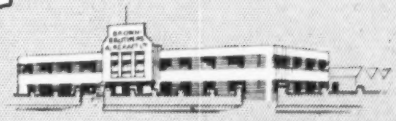

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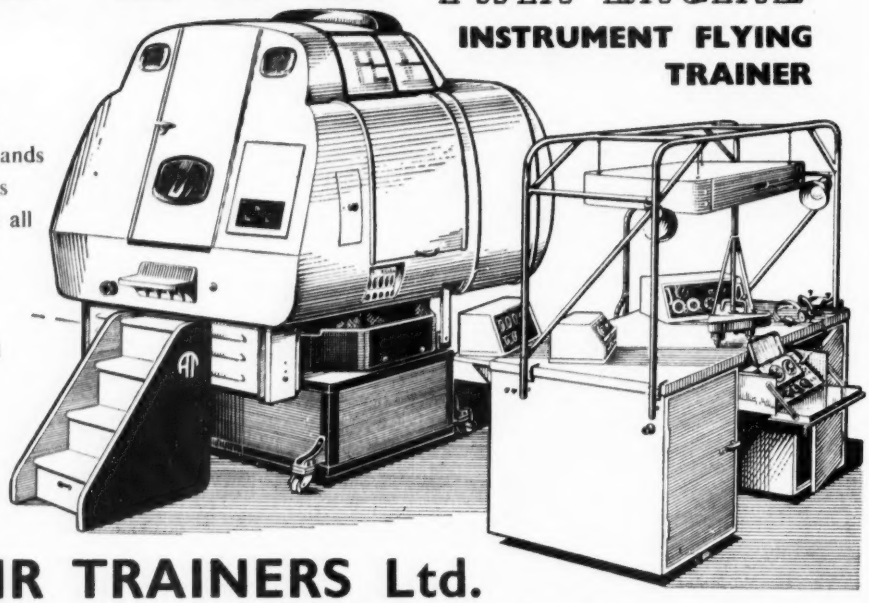

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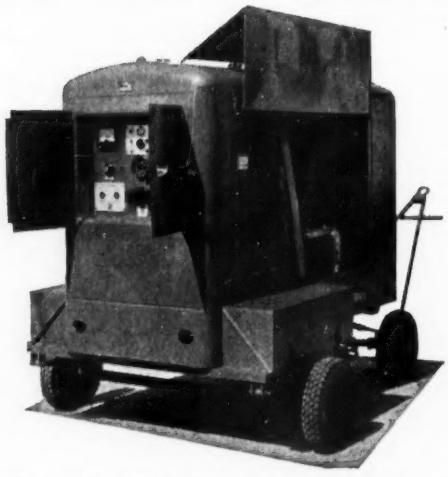

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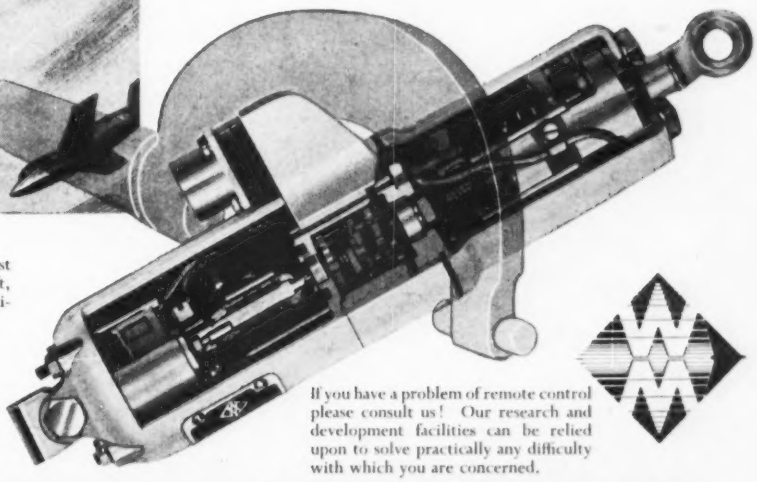

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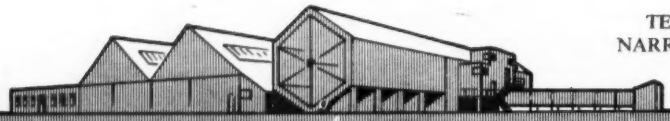

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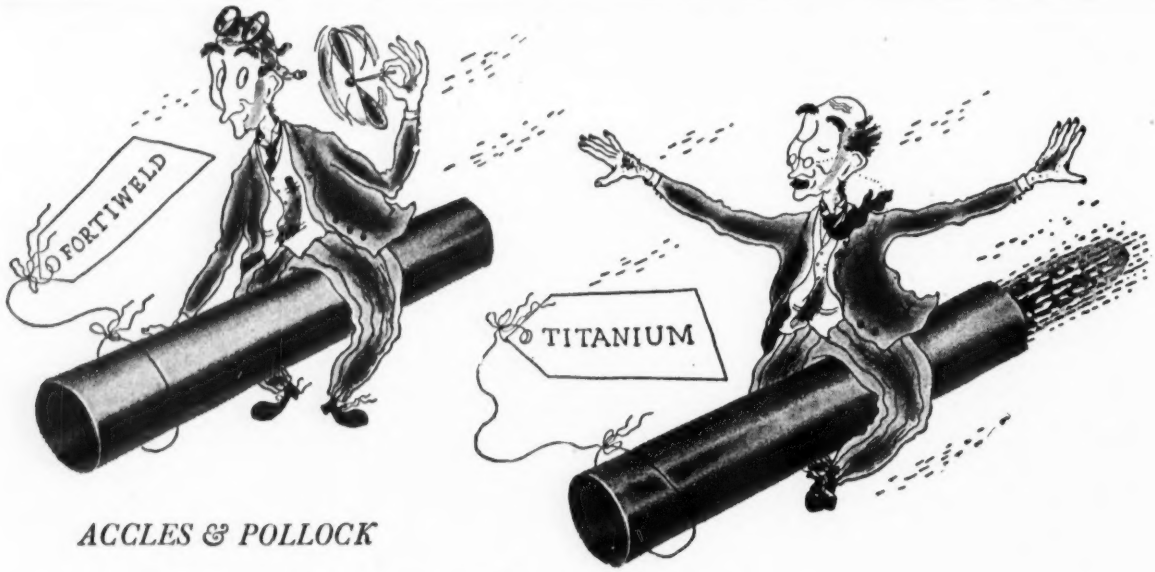

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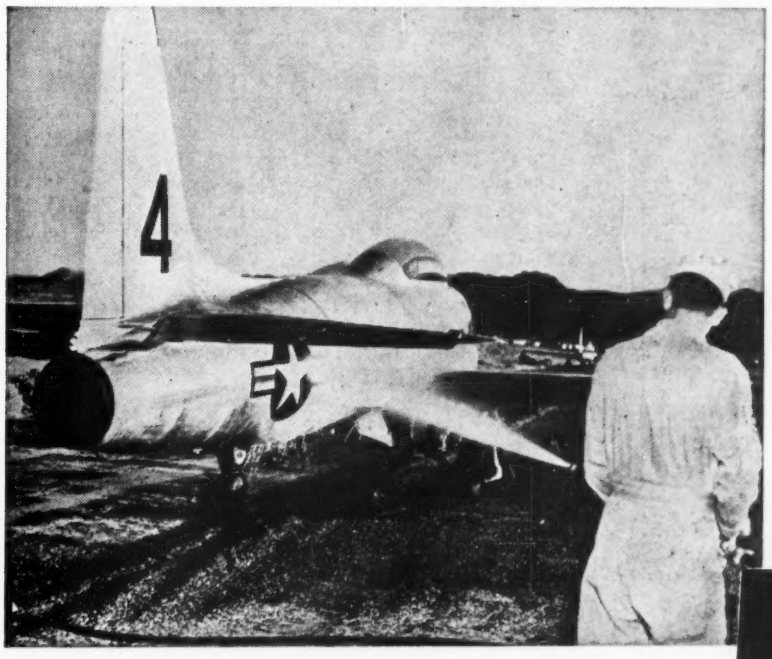

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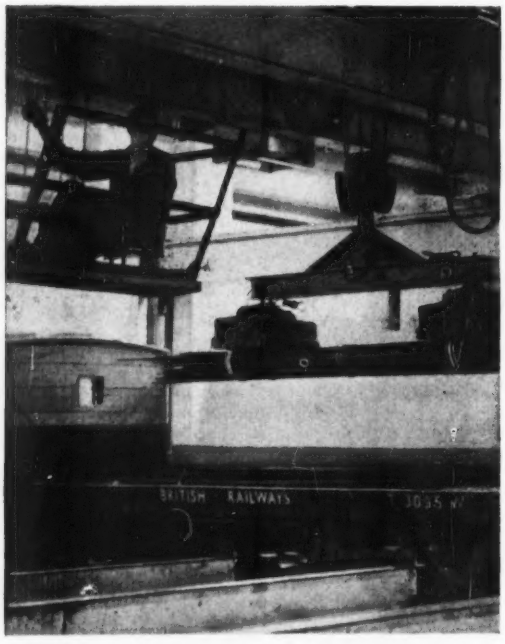

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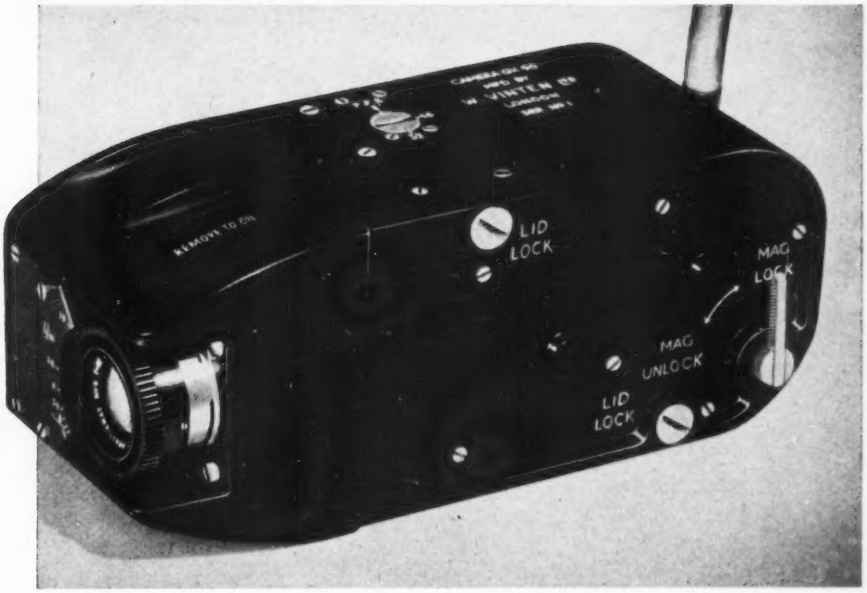

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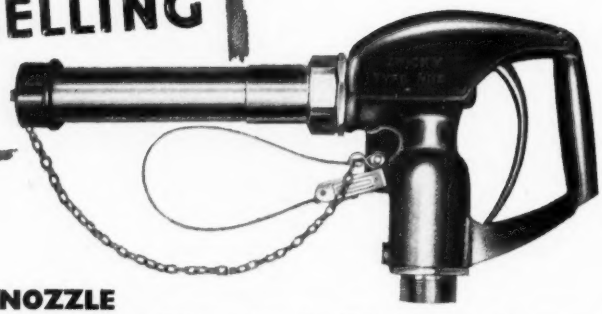

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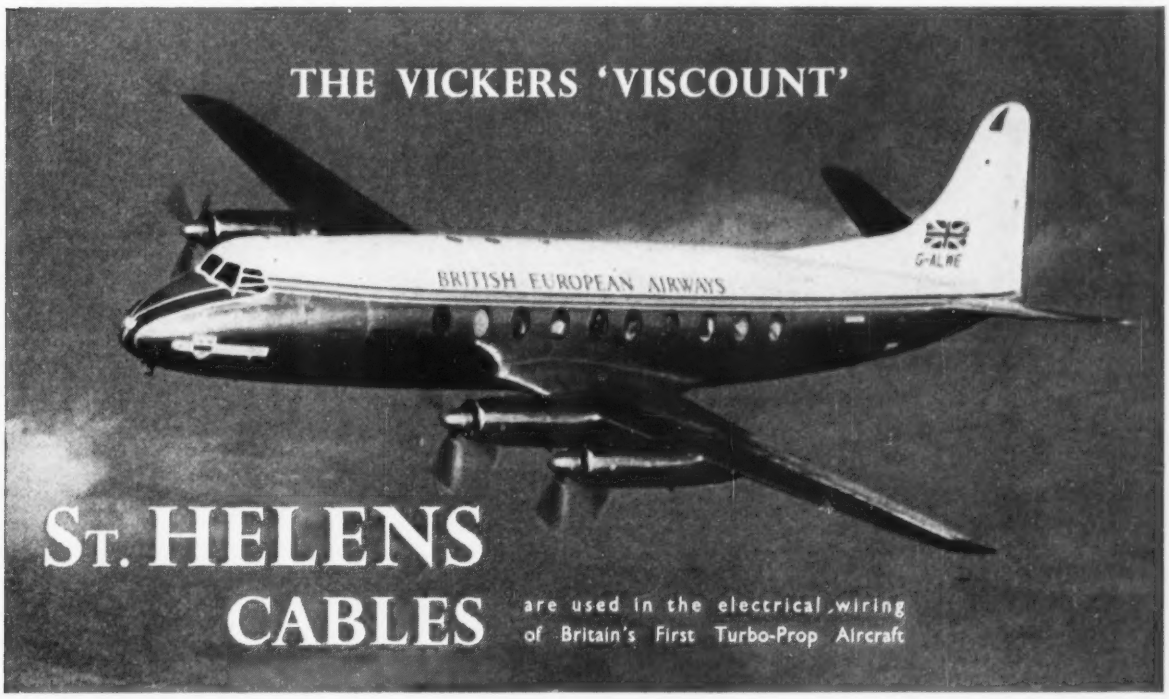

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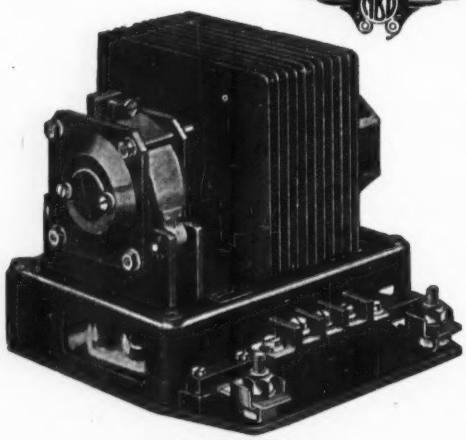

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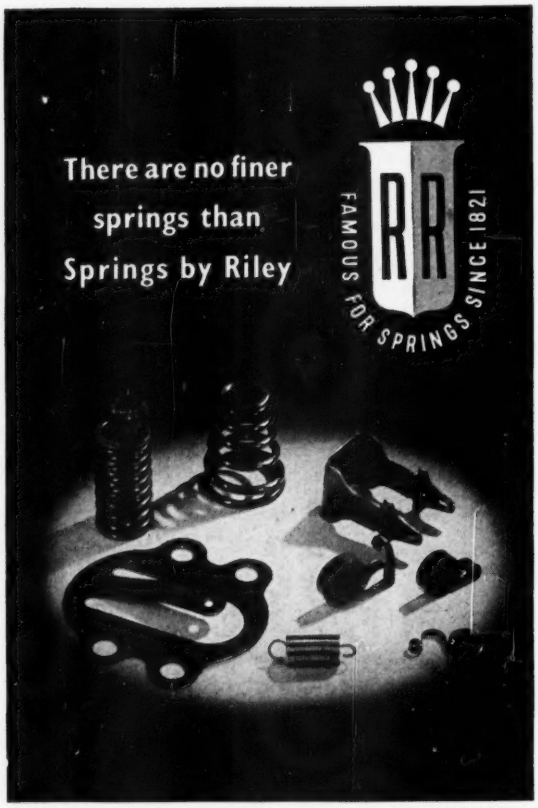

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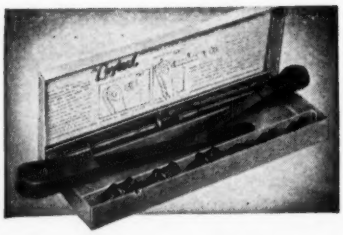

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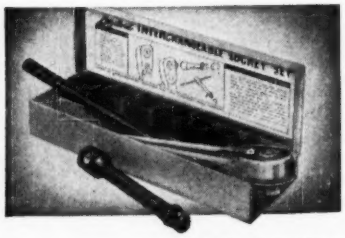

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PUBLIC ANNOUNCEMENTS

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THE Air Transport Advisory Council give notice that they have received the undermentioned applications to operate scheduled air services:—

Application No. 227 from British Overseas Airways Corporation, of Airways House, Great West Road, Brentford, Middlesex, for approval to make a terminal or intermediate traffic stop at Manchester on their normal scheduled services between the United Kingdom and Boston and/or New York, and between the United Kingdom and Bermuda or Nassau on the routes set out as Routes 19 and 23 respectively in Schedule "A," Part I, of the terms of reference issued to the Air Transport Advisory Council by the Minister of Civil Aviation on July 30th, 1952.

From Air Kruise, Ltd., of Lympne Airport, near Hythe, Kent:—

Application No. 228 for a seasonal inclusive tour service with Dakota aircraft for the carriage of passengers between Lympne and Zurich (Kloten) at a frequency of from two to five services weekly during the season from April to October inclusive, for a period of three years commencing April 1st, 1954.

Application No. 229 for a seasonal inclusive tour service with Dakota aircraft for the carriage of passengers between Lympne and Basle (Mulhouse) at a frequency of from one to two services weekly during the season from April to October inclusive, for a period of three years commencing April 1st, 1954.

THESE applications will be considered by the Council under the terms of reference issued to them by the Minister of Civil Aviation on July 30th, 1952. Any representations or objections with regard to these applications must be made in writing, stating the reasons, and must reach the Council within 14 days of the date of this advertisement, addressed to the Secretary, Air Transport Advisory Council, 9 Buckingham Gate, London S.W.1, from whom further details of the applications may be obtained. When an objection is made to an application by another air transport company on the grounds that they are applying to operate the route or part of route in question, their application, if not already submitted to the Council, must reach them within the period allowed for the making of representations or objections. [1391

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(5) Radar Assistants

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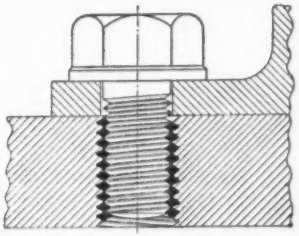

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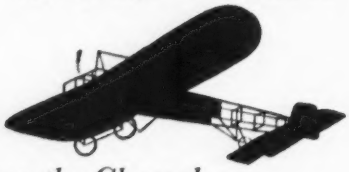

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